(1)

RECONNAISSANCE REPORT

FLOOD CONTROL AND OTHER WATER-RELATED PURPOSES

WYACONDA RIVER BASIN, MISSOURI AND IOWA

DECEMBER 1991

US Army Corps of Engineers
Rock Island District

REVISED MARCH 1992

A250 057

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DECEMBER 1991

US Army Corps
of Engineers
Rock Island District

REVISED MARCH 19

CENCD-PE-PD-PF (CENCR-PD-F/December 1991) (1105) 1st End
Mr. Jackson/cld/(312) 886-5471
SUBJECT: Wyaconda River Basin, Missouri and Iowa

Cdr, North Central Division, U.S. Army Corps of Engineers,
111 N. Canal Street, Chicago, IL 60606-7205 8 APR 1992

FOR HQUSACE (CECW-P), WASH DC 20314-1000

1. Concur with the district commander's recommendation.

2. The HQ, NCD, POC is Mr. Elihu Jackson, CENCD-PE-PD-PF, (312) 886-5471.

RUSSELL L. FUHRMAN
Brigadier General, USA
Commanding

DEPARTMENT OF THE ARMY
NORTH CENTRAL DIVISION, CORPS OF ENGINEERS
111 NORTH CANAL STREET
CHICAGO, ILLINOIS 60606-7205

April 15, 1992

REPLY TO
ATTENTION OF:

NOTICE OF COMPLETION OF FINAL RECONNAISSANCE REPORT ON WYACONDA RIVER BASIN, MISSOURI AND IOWA

This is a notice that the final reconnaissance report on the Wyaconda River Basin, Missouri and Iowa, study has been completed by the District Engineer, Rock Island District, U.S. Army Corps of Engineers, Rock Island, Illinois, and the Division Engineer, North Central Division, U.S. Army Corps of Engineers, Chicago, Illinois.

AUTHORITY

The study was authorized by a resolution of the House Committee on Public Works and Transportation, adopted on September 23, 1987. The purpose of the study was to determine the feasibility of measures for flood control and other water-related purposes in the Wyaconda River Basin, Missouri and Iowa, with particular reference to Clark and Lewis Counties, Missouri.

BACKGROUND

The Wyaconda River Basin is located in Davis and Van Buren Counties, Iowa; and Scotland, Clark, and Lewis Counties, Missouri. The basin is approximately 70 miles in length and 8 miles wide and has a total drainage area of 458 square miles. The basin is predominantly rural and agricultural, except for the four incorporated communities in Missouri: Arbela, Granger, Luray, and Wyaconda.

This study concentrated on the investigation of alternatives to reduce flooding problems along the main stem of the Wyaconda River, downstream of the confluence of the North Wyaconda and South Wyaconda Rivers, in Clark and Lewis Counties, Missouri. The

flooding problems of other portions of the Wyaconda River Basin have either been studied or under consideration for study by the Soil Conservation Service of the U.S. Department of Agriculture.

PROBLEMS IDENTIFIED AND ALTERNATIVES CONSIDERED

Flood damages along the main stem of the Wyaconda River, in Clark and Lewis Counties, Missouri, include crop losses, loss of and damage to agriculture land, and damage to roads and bridges.

Alternatives investigated during the study to alleviate the flooding problems included a dam and reservoir, channelization, diversion channel, levees, bridge modifications, permanent floodplain evacuation, and a flood warning system. Each of the structural and nonstructural alternatives investigated was found to be economically infeasible.

RECOMMENDATION

The reconnaissance study investigations found none of the flood damage reduction alternatives analyzed for the Wyaconda River Basin in Clark and Lewis Counties, Missouri, to be economically justified. I, therefore, concur with the recommendation of the district engineer that this study be terminated.

REVIEW PROCESS AND ADDITIONAL PUBLIC INPUT

This report is being submitted to the Washington Level Review Center (WLRC) for review and decision making by the Board of Engineers for Rivers and Harbors, Office of the Chief of Engineers, and the Assistant Secretary of the Army for Civil Works.

Interested parties may present written views on the report to the WLRC. We request that information submitted be new, specific in nature, and bear directly on the findings in the report. Previous statements made on the report or views expressed at public meetings are available to the WLRC.

Written communications should be mailed to the Washington Level Review Center, Kingman Building, Fort

Belvoir, Virginia 22060-5576, in time to reach the WLRC by May 15, 1992. If extension of this date is necessary, a written request stating reasons for additional time should be mailed to the WLRC soon after receipt of this notice. Information furnished by mail is given equal consideration and weight as information furnished at public meetings.

Copies of information received by mail will not be furnished to other parties. However, such information will be regarded as public information, unless the correspondent limits its effective value by requesting otherwise. This information may be inspected and notations made by other interested parties in the office of the WLRC.

The Board of Engineers for Rivers and Harbors will not take final action on the report until after expiration of this notice or any extension that may be granted.

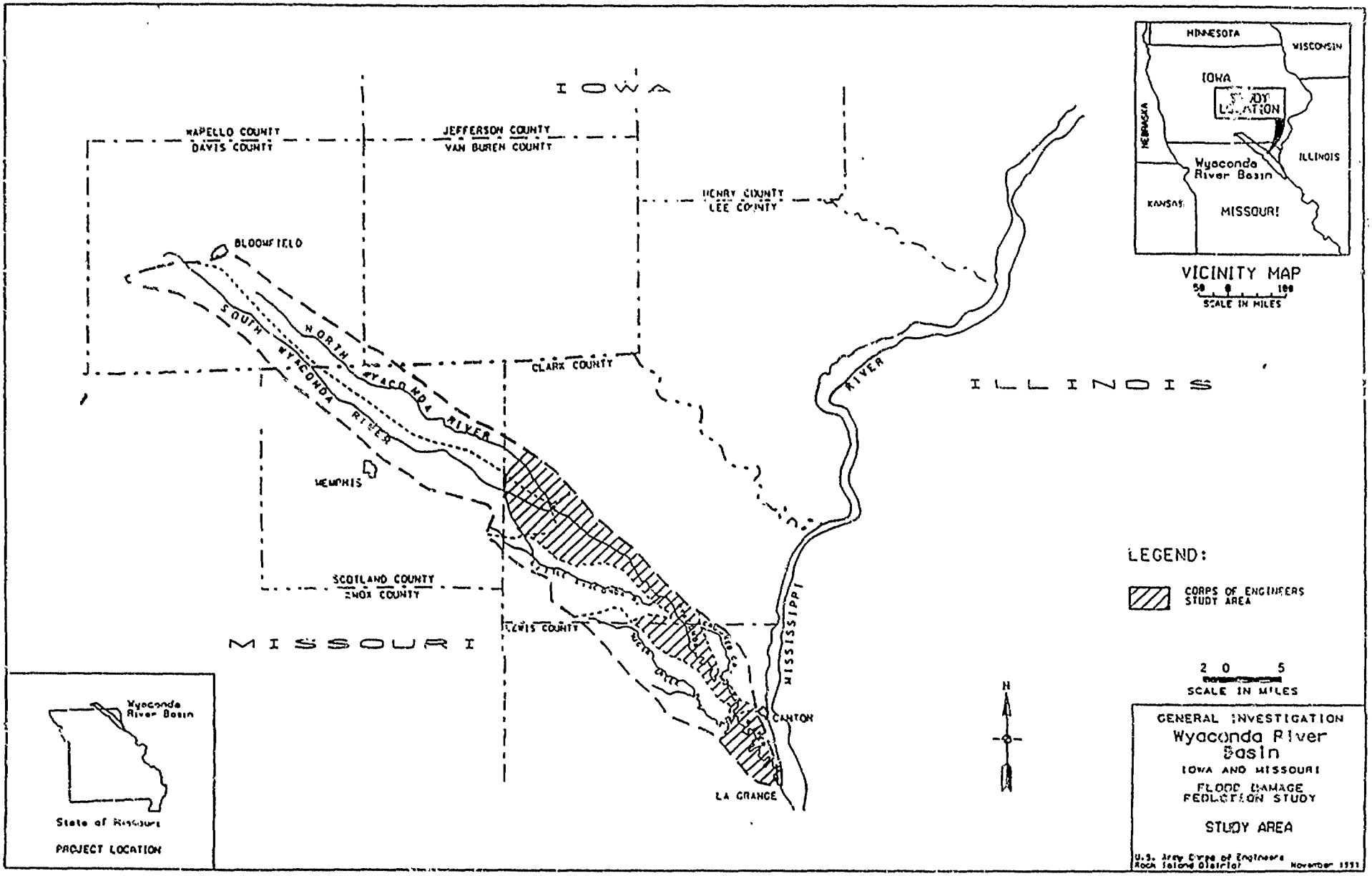
FURTHER INFORMATION

Further information may be obtained from this office or from the District Engineer; Rock Island District; U.S. Army Corps of Engineers; Clock Tower Building, Post Office Box 2004; Rock Island, Illinois 61204-2004. Additional copies of the report will be available until the limited supply is exhausted. You are requested to give this public notice to anyone known by you who may be interested in the report but did not receive a copy.

Thank you for your continued interest in our activities.

Russell L. Fuhrman
Brigadier General, U.S. Army
Commanding General and
Division Engineer

Attachment


IOWA
WAPELLO COUNTY
DAVIS COUNTY
JEFFERSON COUNTY
VAN BUREN COUNTY
HENRY COUNTY
LEE COUNTY
BLOOMFIELD
SOUTH WYACONDA RIVER
NORTH WYACONDA RIVER
CLARK COUNTY
MEMPHIS
ILLINOIS
MISSISSIPPI RIVER
SCOTLAND COUNTY
KNOX COUNTY
LEWIS COUNTY
MISSOURI
CANTON
LA GRANGE
MINNESOTA
WISCONSIN
NEBRASKA
ILLINOIS
KANSAS
MISSOURI
Wyaconda River Basin
VICINITY MAP
50 0 100
SCALE IN MILES
LEGEND:
CORPS OF ENGINEERS STUDY AREA
2 0 5
SCALE IN MILES
N
Wyaconda River Basin
State of Missouri
PROJECT LOCATION
GENERAL INVESTIGATION
Wyaconda River Basin
IOWA AND MISSOURI
FLOOD DAMAGE REDUCTION STUDY
STUDY AREA
U.S. Army Corps of Engineers Rock Island District
November 1991

ATTACHMENT

DEPARTMENT OF THE ARMY
ROCK ISLAND DISTRICT, CORPS OF ENGINEERS
CLOCK TOWER BUILDING – P.O. BOX 2004
ROCK ISLAND, ILLINOIS 61204-2004

REPLY TO
ATTENTION OF

CENCR-PD-F

RECONNAISSANCE REPORT
FLOOD CONTROL AND OTHER WATER-RELATED PURPOSES
WYACONDA RIVER BASIN, MISSOURI AND IOWA

DECEMBER 1991

REVISED MARCH 1992

ACKNOWLEDGMENT

This report was prepared by a Rock Island District, U.S. Army Corps of Engineers, multi-disciplinary study team. Individuals familiar with the technical aspects of the study are listed below:

STUDY MANAGEMENT & PLAN FORMULATION	George Gicter, AICP
HYDROLOGY AND HYDRAULICS	David Martin, P.E.
ECONOMIC ANALYSIS	Louise Zawlocki
ENVIRONMENTAL RESOURCES	Charlene Carmack
CULTURAL RESOURCES	Ken Barr
COST ESTIMATING	Kent Stenmark
GEOTECHNICAL	Don Bawman
TECHNICAL ASSISTANCE	Diane DeMeyer

SYLLABUS

This reconnaissance study was authorized by resolution of the Committee on Public Works and Transportation, U.S. House of Representatives, on September 23, 1987. The study was authorized for flood control and other water-related purposes in the Wyaconda River basin, Missouri and Iowa. The Clark County, Missouri, Commission issued letters of support for the study on July 15, 1988; June 22, 1989; and June 4, 1990. A Notice of Initiation for the reconnaissance study was sent to the public on February 5, 1991.

The reconnaissance study investigated a full range of flood damage reduction measures including dams, channelization, diversion channel, levees, and floodplain evacuation.

The study concentrated on the main stem of the Wyaconda River basin downstream of the confluence of the North Wyaconda and South Wyaconda Rivers in Clark and Lewis Counties, Missouri. Other subbasins in the Wyaconda River basin have either been studied or have applications on file with the U.S. Department of Agriculture-Soil Conservation Service under the authority of Public Law 83-566, the Watershed Protection and Flood Prevention Act.

A public open house was held at the Clark County, Missouri, Court House on May 20, 1991. Approximately 55 people attended the open house to comment on the study and to help formulate flood damage reduction plans.

All of the alternatives examined in the report lack economic justification, and, therefore, the study has been terminated.

RECONNAISSANCE REPORT
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DISTRIBUTION LIST

RECONNAISSANCE REPORT
FLOOD CONTROL AND OTHER WATER-RELATED PURPOSES
WYACONDA RIVER BASIN, MISSOURI AND IOWA

SECTION 1 - INTRODUCTION

STUDY AUTHORITY

The study was authorized by resolution of the Committee on Public Works and Transportation, U.S. House of Representatives, on September 23, 1987. The resolution is as follows:

> Resolved by the Committee on Public Works and Transportation of the United States House of Representatives, that the Board of Engineers for Rivers and Harbors is hereby requested to review the report of the Chief of Engineers on the Wyaconda River, Missouri and Iowa, published as House Document numbered 273, Seventy-fourth Congress, and other pertinent reports, with a view to determining the feasibility of measures for flood control and other water-related purposes in the Wyaconda River basin, Missouri and Iowa, with particular reference to Clark and Lewis Counties, Missouri.

STUDY PURPOSE AND SCOPE

The purpose of the reconnaissance phase is to conduct a study and produce a report to accomplish the following:

a. Define problems and opportunities and identify potential solutions.

b. Determine whether the planning should proceed further, into a feasibility phase, based on a preliminary appraisal of consistency with Army policies, cost, benefits, and environmental impacts of the identified potential solutions.

c. Estimate time and costs for the feasibility phase.

d. Assess the level of interest and support of non-Federal interests in the identified potential solutions.

This report is the final response to the study authority.

The Wyaconda River basin is located in the northeastern corner of the State of Missouri and the southeastern corner of the State of Iowa. Plate 1 shows the study area.

The study area includes only the main stem of the Wyaconda River basin downstream from the confluence of the North Wyaconda and South Wyaconda Rivers in Clark and Lewis Counties, Missouri. Other subbasins of the Wyaconda River basin have been studied or have applications on file with the U.S. Department of Agriculture-Soil Conservation Service under the authority of Public Law 83-566, the Watershed Protection and Flood Prevention Act (see plate 2).

RELATED STUDIES, REPORTS, AND EXISTING WATER PROJECTS

1. *Review of Reports for Flood Control and Allied Purposes on the Wyaconda River, Missouri and Iowa*, U.S. Army Engineer District, Rock Island, Corps of Engineers, Clock Tower Building, Rock Island, Illinois, February 24, 1965. The report investigated flood control and allied purposes in the Wyaconda River basin. All plans for flood control were found to lack economic justification.

2. *Flood Hazard Boundary Map, Clark County, Missouri, Unincorporated Area*, National Flood Insurance Program, Federal Emergency Management Agency, Federal Insurance Administration, Effective Date: September 15, 1981. The maps identify special flood hazard areas.

3. *Flood Hazard Boundary Map, Lewis County, Missouri, Unincorporated Area*, National Flood Insurance Program, Federal Emergency Management Agency, Federal Insurance Administration, Effective Date: September 22, 1981. The maps identify special flood hazard areas.

4. *Little Wyaconda-Sugar Creek Watershed, Watershed Plan-Environmental Assessment, Lewis, Clark, and Scotland Counties, Missouri*, U.S. Department of Agriculture, Soil Conservation Service, Columbia, Missouri, April 1983. The report describes a plan to reduce soil erosion and improve water quality in the Little Wyaconda-Sugar Creek watershed.

5. *Iowa Watershed Progress Report*, U.S. Department of Agriculture, Soil Conservation Service, March 1991. The report references the completed watershed project on the Big Wyacondah (South Wyaconda) and the application awaiting action on the North Wyacondah (North Wyaconda).

SECTION 2 - PLAN FORMULATION

ASSESSMENT OF PROBLEMS AND OPPORTUNITIES

PROBLEMS AND OPPORTUNITIES

Agricultural lands along the main stem of the Wyaconda River in Clark and Lewis Counties, Missouri, are subject to overbank flooding which causes crop and road damage, erosion, and deposition.

There is an opportunity to reduce crop and road damages due to overbank flooding from the main stem Wyaconda River in Clark and Lewis Counties, Missouri.

EXISTING CONDITIONS

Hydrology and Hydraulics

The Wyaconda Basin is located in southeastern Iowa and northeastern Missouri. The basin is about 70 miles long, 8 miles wide, and has a drainage area of 458 square miles at the mouth. This study concentrated on the main stem of the Wyaconda River.

The flow frequencies were calculated using the U.S. Geological Survey (USGS) gage at Canton, Missouri, expanded by the USGS gage on the North Fabius River at Monticello, Missouri. The resulting frequencies for the Wyaconda River at Canton are as follows: 10 percent at 12,800 cubic feet per second (cfs), 2 percent at 21,800 cfs, 1 percent at 26,500 cfs, and 0.5 percent at 31,800 cfs.

The water surface profiles were calculated using the Standard Step backwater method of the HEC-2 computer program. The model was set up using surveyed bridge openings and USGS 20-foot contour maps to develop cross sections and reach lengths.

Additional information can be found in Appendix A-Hydrology and Hydraulics.

Economic and Social

The Wyaconda River Basin is located within Davis and Van Buren Counties, Iowa, and Scotland, Clark, and Lewis Counties, Missouri. The study area encompasses the Wyaconda River main stem in Clark and Lewis Counties.

Four incorporated communities are within the Wyaconda River basin, all within Missouri: Arbela, Granger, Luray, and Wyaconda. Land use in the study area is in agricultural production.

Transportation service for the study area is from State Highway 81 along the east side, State Highway 16 to the south, numerous county highways to the west, and U.S. Route 136 to the north.

The study area is subject to flood-induced agricultural, transportation, and road damages. The estimated average annual damages for existing condition crop losses in the study area are $1,477,000.

Scattered throughout the study area are numerous privately constructed levees which provide varying degrees of protection to the area. These levees provide no systematic flood control system. Additional information is provided in Appendix B-Economic Analysis.

Geology and Soils

Topography - The Wyaconda River system has incised itself into the geomorphic province known as the Dissected Glacial Till Plain. This province is composed of Kansan age, or possibly older, glacial till overlain by a mantle of loess. It is generally characterized by a relatively flat, loess-covered upland, moderately steep valley walls, and moderately broad valley floors. This is essentially the nature of the Wyaconda drainage basin. The basin is extremely narrow and generally straight from its head near Bloomfield, Iowa, to its mouth near La Grange, Missouri. The upper three-quarters of the basin has flat, loess-covered uplands between valleys, with till walls of a slope seldom greater than 20 percent and generally less than 14 percent. The normal elevation change from upland to valley floor is a relatively constant 100 to 120 feet. Originally, the streams meandered along flat valley floors of loess and till alluvium Recently, however, many stretches have been dredged and straightened. In the lower reach of the basin, the valleys narrow, the valley walls steepen, and the river retains its original sinuosity. From the vicinity of Canton, the river impinges against very steep bluffs or rock cliffs until it debouches onto the Mississippi River valley floor near La Grange.

Surficial Geology - The unconsolidated surface deposits range from zero to 400 feet thick, but generally vary from 25 to 250 feet. The uppermost unit is the wind-blown loess which is silt-size material that was blown from the glacial sluiceways onto the adjacent till plains. It generally ranges from

5 to 10 feet in thickness, but locally may approach 50 feet. Beneath this is Kansan age glacial till composed of a heterogeneous mix of boulders, gravels, sands, silts, and clays. The upper zone of the till is a developed paleosol which grades downward into the unleached till. Thickness in the till ranges from 20 to 200 feet. Underlying some areas of till are pre-Kansan alluvial deposits of channel sands and gravels. Modern streams have cut down through the loess and till to form typical alluvial valley deposits which are generally less than 50 feet thick.

Bedrock Geology - The basin area is underlain by Paleozoic sedimentary rocks. From the headwaters to approximately the Scotland-Clark County, Missouri, border, the bedrock surface is represented by the Pennsylvanian age Cherokee Group, composed of predominantly sandstones, siltstones, and shales, with interspersed limestones and coals, varying up to 250 feet thick. The underlying and older Mississippian Merimecian Series comprises the bedrock surface from roughly the Scotland-Clark County border to the vicinity of Canton, Missouri, where the Osagean Series is expressed to the vicinity of La Grange. The Mississippian rocks are predominantly carbonates with abundant chert and occasional shale beds from 200 to 450 feet thick. Below this are roughly 1,000 feet of Devonian and Ordovician carbonates with interbedded shales and sandstones. The Cambrian strata are predominantly sandstones with shales and carbonates, all of which rest on the Precambrian basement.

Hydro-Geology - Surficial aquifers are of three types. Alluvial aquifers exist in the shallow, modern valley sediments of silts, sands, and gravels and produce moderate to large yields (25 to 100 gpm). The glacial drift contains occasional irregular bodies of sand and gravel which can produce locally but are generally low (less than 10 gpm). Pre-drift buried channel deposits of sands and gravels are relatively extensive and can produce large yields. The Pennsylvanian rocks, where present, function as an aquiclude overlying the Mississippian aquifer which gives moderate to low yields. Below this is an alternating succession of aquicludes and aquifers of varying yields down to the Precambrian which is the base of the ground water reservoir.

Historic Properties

Few systematic archeological surveys have been conducted for the Wyaconda River basin. The minimal data available suggest that cultural developments seem to parallel those of the better known Salt River basin to the south.

Sites dating from the Archaic through Mississippian periods are anticipated. [1]

Each alternative considered has a potential to impact significant historic properties, and detailed inventory and evaluation studies would be required as part of any future Federal flood control study for the project area. Impacts to both historic structures (bridges, buildings) and archeological sites would need to be assessed for compliance with the National Historic Preservation Act.

Biological

The study area is primarily agricultural in character. The Wyaconda River is the principal aquatic resource in the area. The river flows in a generally southeasterly direction from its headwaters in Davis County, Iowa; through Scotland, Clark, and Lewis Counties in Missouri; and empties into the Mississippi River at the town of La Grange, Missouri. The majority of the basin's acreage is in row crop production.

Following initiation of the reconnaissance study, various Federal and State resource agencies were requested to provide input or comments concerning existing environmental conditions, problems, and opportunities in the study area. The U.S. Fish and Wildlife Service (USFWS), the U.S. Environmental Protection Agency, the Missouri Department of Conservation, the Missouri Department of Natural Resources, and the U.S. Department of Agriculture-Soil Conservation Service, provided information and assistance for the assessment of biological resources in the study area. Copies of coordination letters from these agencies are contained in Appendix C-Pertinent Correspondence.

The Planning Assistance Letter provided by the USFWS to the Rock Island District reported that aquatic habitat in the Wyaconda River basin has been severely reduced and constrained by historic and contemporary alteration of natural drainage patterns and vegetative cover. The upper part of the main stem of the Wyaconda, the primary focus of this study, has been extensively channelized, as have the headwaters of the river and its tributaries. The USFWS estimates that the river has lost approximately 50 percent of its length with a corresponding decrease in aquatic habitat.

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[1] Wright, Christopher A., 1987, Part B: Study Units in *Master Plan for Archeological Resource Protection in Missouri*, D. Weston and M. Weichman (editors).

Cultivation activities also have increased the rate of erosion, sedimentation, and organic inputs, further contributing to deterioration of aquatic habitat. Despite these limiting factors, the river and its tributaries support a viable warm-water fishery. At least 52 fish species are known to occur in the Wyaconda River system. Common species are listed in the Planning Assistance Letter.

Terrestrial habitat in the study area also has been significantly affected by agricultural activities. Pre-settlement prairie vegetation has been virtually eradicated, and upland forest habitat has been reduced by grazing and timber harvesting. The largest amount of remaining natural vegetation exists in fragmented tracts of bottomland forest located along the current and historic channels of the Wyaconda River and its tributaries. Wildlife species which inhabit the area are primarily species which utilize more than one habitat type and are commonly found in agricultural-edge environments. A partial listing of avian and mammal species found in the study area is provided in the Planning Assistance Letter.

Examination of the USFWS's National Wetlands Inventory maps revealed that wetland resources in the study area are primarily palustrine forested, shrub-scrub or emergent wetlands associated with the floodplain of the Wyaconda River. Wetland resources in the uplands adjacent to the study area are primarily associated with farm ponds (unconsolidated bottom wetlands). The Planning Assistance Letter states that the Soil Conservation Service's wetlands inventory findings are similar to those of the USFWS inventory, and that the Soil Conservation Service inventory additionally identified a large number of farmed wetlands in the floodplain of the Wyaconda.

The USFWS has determined that the following federally listed endangered or threatened species may occur in the study area: the bald eagle (*Haliaeetus leucocephalus*), the fat pocketbook pearly mussel (*Potamilus capax*), the Higgins' eye pearly mussel (*Lampsilis higginsi*), and the Indiana bat (*Myotis sodalis*). No designated critical habitat for any of these species occurs in the study area. The Missouri Department of Conservation reported that another federally listed species, the winged mapleleaf mussel (*Quadrula fragosa*), may potentially occur in the study area; however, the USFWS report contained no reference to this species. The Department of Conservation also reported that the following State-listed endangered species may occur in the study area: Blanding's turtle (*Emydoidea blandingii*), the western fox snake (*Elaphe vulpina vulpina*), the eastern massasauga (*Sisturus catenatus catenatus*), the central mudminnow (*Umbra limi*), and the dotted monarda (*Monarda punctata*).

Coordination with the U.S. Environmental Protection Agency disclosed that their CERCLIS (abandoned, inactive, or uncontrolled hazardous waste sites) data base contained no records of CERCLIS sites within the study area, although there are several recorded sites in the headwaters of the basin in Iowa and one in the city of La Grange, Missouri. The lack of recorded sites in the study area does not necessarily preclude the existence of

presently unknown CERCLIS sites, but it is perhaps indicative of the essentially rural nature of this area.

The downstream portion of the Wyaconda River below the reconnaissance study area has been recognized by the Department of Natural Resources for its scenic and recreational value, and by the Department of Conservation's Natural Areas Inventory as a "significant area" because of numerous undisturbed upland plant communities located on the bluff line and adjacent ravines.

Should more detailed flood control studies be undertaken at some future date, more extensive analysis and coordination of potential impacts to environmental resources will be required. For studies culminating in a recommendation for project construction or other Federal action, a NEPA document will be required. Resource agencies which provided comments and input regarding the alternatives investigated during this study generally recommended against structural solutions that would increase the physical alteration of the original river channel and floodplain.

FUTURE CONDITIONS

Because of the existing flooding problems, farmers incur increasing expenses and crop losses. A continually rising expense is to adequately maintain roads and drainage ditches because of the flooding problem. If no action is taken, flooding will continue to inundate the study area, and the resultant expenses and losses will diminish economic resources.

PLANNING OBJECTIVES

NATIONAL OBJECTIVES

The Federal objective of water and related land resources planning is to contribute to national economic development consistent with protecting the Nation's environment, pursuant to national environmental statutes, applicable executive orders, and other Federal planning requirements.

Contributions to national economic development (NED) are increases in the net value of the national output of goods and services, expressed in monetary units. Contributions to NED are the direct net benefits that accrue in the planning area and the rest of the Nation. Contributions to NED include increases in the net value of those goods and services that are marketed, and also of those that may not be marketed.

SPECIFIC OBJECTIVES WITHIN THE STUDY AREA

It is a specific objective in the study area to reduce damages from overbank flooding on the main stem of the Wyaconda River in Clark and Lewis Counties, Missouri.

PLANNING CONSTRAINTS

A number of planning constraints must be considered in the formulation of project alternatives. In general, the study is constrained by all applicable laws of the United States and the States of Iowa and Missouri, all Executive Orders of the President, the Water Resources Council's Principles and Guidelines, and all regulations of the Corps of Engineers.

DEVELOPMENT OF ALTERNATIVE PLANS

AVAILABLE MEASURES

The range of available measures can be divided into two categories: structural and nonstructural. Structural measures include dams with reservoirs/dry dams, channelization, diversion channel, levees and floodwalls, and bridge modifications. All such measures reduce the frequency or extent of damaging flows.

Nonstructural measures include permanent floodplain evacuation and a flood-warning system. These may be used alone or in conjunction with structural measures.

FORMULATION CRITERIA

Plans are formulated in consideration of four criteria:

a. Completeness is the extent to which a given alternative plan provides and accounts for all necessary investments or other actions to ensure the realization of the planned effects. This may require relating the plan to other types of public or private plans if the other plans are crucial to realization of the contributions to the objective.

b. Effectiveness is the extent to which an alternative plan alleviates the specified problems and achieves the specified opportunities.

c. Efficiency is the extent to which an alternative plan is the most cost effective means of alleviating the specified problems and realizing

the specified opportunities, consistent with protecting the Nation's environment.

d. Acceptability is the workability and viability of the alternative plan with respect to acceptance by State and local entities and the public and compatibility with existing laws, regulations, and public policies.

A plan that reasonably maximizes net economic development benefits, consistent with the Federal objective, is to be formulated. This plan is to be identified as the national economic development plan.

DESCRIPTION OF PLANS

Seven alternatives were formulated for the study area:

Dam with Reservoir/Dry Dam

A reservoir is a man made lake used to temporarily store excess runoff. These structures are constructed upstream of areas that encounter significant flooding problems. In order to protect the study area, reservoirs would have to be placed on both the North and South Wyaconda Rivers. The North Wyaconda reservoir would require about 3 square miles, and the South Wyaconda reservoir would require about 3-1/2 square miles (see plate 3).

Channelization

Channelization improves a stream's conveyance of water by realignment, widening, or deepening of the streambed. Channel modifications of as much as 48 miles in length would be required for this alternative.

There are two alternatives for the construction of a channel. The long channel would start near the confluence of the North Wyaconda and South Wyaconda Rivers and extend as far as the confluence with the Mississippi River. The short channel would start near the confluence of the North Wyaconda and South Wyaconda Rivers and extend as far as the area of the Clark/Lewis county line (see plate 3).

Diversion Channel

A diversion channel would be constructed in the vicinity of Canton, Missouri, to divert the Wyaconda River to the Mississippi River. The diversion channel would be about 8,000 feet in length (see plate 3).

Levees and Floodwalls

A system of 12 levees was formulated for the broad floodplain area extending from the confluence of the North Wyaconda and South Wyaconda Rivers downstream to the area of the Clark/Lewis county line (see plates 4 to 6). There would be six levees on the left descending bank (Left 1 thru 6) and six levees on the right descending bank (Right 1 thru 6). Levees would be constructed of compacted earthen fill with 3 horizontal to 1 vertical side slopes and a 10-foot top. Existing roads would be ramped over the levee. Measures would be included for pumping or ponding interior drainage. Levee alternatives were formulated for the 10-, 100-, and 500-year levels of protection.

Bridge Modifications

Modifications to bridges are performed when the bridges impede stream flow. By modifying or removing the bridge, flood profiles can be lowered, which may reduce flooding in affected areas.

There are 15 bridges on the Wyaconda River downstream from the confluence of the North and South Wyaconda Rivers. Bridges are listed in table 1 and located on plate 7.

TABLE 1

Bridges on the Wyaconda River
Downstream of Confluence of
North Wyaconda and South Wyaconda Rivers

Bridge	Approximate Distance Above Mouth (Miles)
Burlington Northern RR	0.1
State Highway B	0.2
U.S. Highway 61	6.6
State Highway V	8.3
State Highway C	13.3
State Highway 16	16.7
County Road	20.3
State Highway E	26.9
County Bridge 367	33.1
County Bridge 358	35.0
County Bridge 264	37.7
County Bridge 257	39.0
State Road D	41.5
County Bridge 238	43.9
A,T&SF Railroad	48.1

Permanent Floodplain Evacuation

Permanent floodplain evacuation involves acquiring affected homes or businesses and relocating the occupants and their possessions to homes or buildings that are outside of the floodplain, of similar worth, and in decent, safe, and sanitary condition. Relocation of homes or businesses involves physically lifting the structure off its present foundation, moving it, and then lowering it onto a suitable foundation outside of the floodplain. Relocation is considered where it is structurally feasible and less costly than evacuation. Some structures, e.g., those constructed of brick or steel, are not normally relocated due to structural limitations.

The area is primarily agricultural, and permanent floodplain evacuation would involve purchasing affected areas and converting land uses to non-agricultural practices. This could include recreation or fish and wildlife purposes. A non-Federal governmental unit would be responsible for managing these areas.

Flood-Warning System

A flood-warning system is a water level sensing device or devices which are connected to an alarm. As water levels rise and reach a potentially threatening level, the alarm is activated. This would alert county officials of imminent flooding and prompt them to warn affected residents via some public address system. Flood-warning systems help to assure residents' safety by providing evacuation time.

EVALUATION OF ALTERNATIVE PLANS

Four accounts are established to facilitate evaluation and display of the effects of alternative plans. These accounts are: national economic development (NED), environmental quality (EQ), regional economic development (RED), and other social effects (OSE). These four accounts encompass all significant effects of the plan on the human environment and encompass social well-being.

The national economic development account shows effects on the national economy. The environmental quality account shows effects on ecological, cultural, and aesthetic attributes of significant natural and cultural resources that cannot be measured in monetary terms. The regional economic development account shows the regional incidence of national economic development effects, income transfers, and employment effects. The other social effects account shows urban and community impacts and effects on life, health, and safety.

An initial evaluation of the slate of alternatives was conducted to identify the options with the greatest likelihood of justification. The evaluation was based upon experience with similar projects, expected benefits and costs, and professional judgment. The following alternatives were eliminated from further consideration as noted.

Dam with Reservoir/Dry Dam - The relatively high cost of constructing a dam would not justify the relatively low value of bridge and crop damages due to flooding. The expected benefit-to-cost ratio would be less than 0.10.

Channelization - The relatively high cost and adverse environmental impacts of constructing a channel would not justify the relatively low value of bridge and crop damages due to flooding. The expected benefit-to-cost ratio would be less than 0.10.

Diversion Channel - The cost of a diversion channel would far exceed the possible level of benefits for the prevention of crop and bridge damages. The diversion channel alternative would cost over $20 million and have a benefit-to-cost ratio less than 0.20.

Flood-Warning System - A flood-warning system would not be practical for the study area since most damages are sustained by crops and bridges.

Floodwalls - Floodwalls can be replaced by less costly earthen levees in the study area.

Bridge Modifications - Damages caused by flooding of bridges and flooding of upstream properties due to higher water surface profiles caused by constrictions are not sufficiently great to justify modifications to existing structures. Bridges in the study area subject to the greatest flood threat have low traffic counts.

Permanent Floodplain Evacuation - The study area floodplain is essentially clear of any structures and there are no opportunities for permanent floodplain evacuation.

A detailed evaluation was made of the levee alternatives for each of 12 reaches as shown on plates 4, 5, and 6. Estimated average annual damages and benefits for a 10-, 100-, and 500-year level of protection were determined and benefit-to-cost ratios computed. Appendix B-Economic Analysis gives this analysis. Table 2 shows the project first costs, average annual costs and benefits, and benefit-to-cost ratios for levees providing protection to the 100-year flooding event. The economic analyses for the 10- and 500-year flooding events had similar benefit-to-cost ratios. "L" refers to the left descending bank of the Wyaconda River and "R" refers to the right descending bank.

TABLE 2

Economic Analysis - 100-Year Level of Protection
(in $1,000's)

Reach	Project First Costs	Average Annual Cost	Average Annual Benefit	Net Benefit	Benefit-to-Cost Ratio
L-1	$ 2,586	$ 230	$ 28	$ (202)	0.12
L-2	2,399	214	36	(178)	0.17
L-3	3,347	298	25	(273)	0.08
L-4	2,503	223	51	(172)	0.23
L-5	2,107	188	31	(157)	0.17
L-6	4,276	380	82	(298)	0.22
R-1	2,711	242	4	(238)	0.02
R-2	2,795	249	41	(208)	0.16
R-3	2,649	236	11	(225)	0.05
R-4	12,517	1,114	100	(1,014)	0.09
R-5	7,216	642	69	(573)	0.11
R-6	5,819	518	178	(340)	0.34

SECTION 3 - SUMMARY OF STUDY MANAGEMENT, COORDINATION, PUBLIC VIEWS & COMMENTS

The Rock Island District, U.S. Army Corps of Engineers, announced the start of the Wyaconda River Basin Study on February 5, 1991, in its *Notice of Initiation of a Reconnaissance Study for Flood Control and Other Water-Related Purposes for the Wyaconda River Basin, Missouri and Iowa.* This notice was mailed to those on the Wyaconda River basin distribution list, which included approximately 200 Federal, State, county, and city governmental agencies and representatives, local media, and residents within the Wyaconda River basin study area. A copy of the Notice of Initiation is included in Appendix C-Pertinent Correspondence.

On May 5, 1991, an invitation to attend an open house was mailed to the Wyaconda River Basin distribution list. The open house was held at the Court House in Kahoka, Missouri, on May 20, 1991. The open house notice was included in Appendix C-Pertinent Correspondence.

Approximately 55 people attended the open house, including local Soil Conservation Service representatives, Clark County commissioners, Wyaconda Basin area farmers and residents, and five Corps of Engineers study team members. The attendees were asked either to fill out a comment sheet at the open house or to take the sheet with them for completion and then mail it to the Corps' Rock Island District office. Attendees were encouraged to take comment sheets to those who could not attend the open house. The comment sheets were used to update the Wyaconda River basin distribution list and to help the study team formulate its study alternatives.

The main problems listed on the comment sheets, listed here in order of number of times mentioned, were flood damage, loss of and damage to crop and pasture land, erosion, damage to roads and bridges, and damage to fences. Among the other concerns were the sharp bends of the Wyaconda River, water quality, and the effects of flooding on livestock and wildlife.

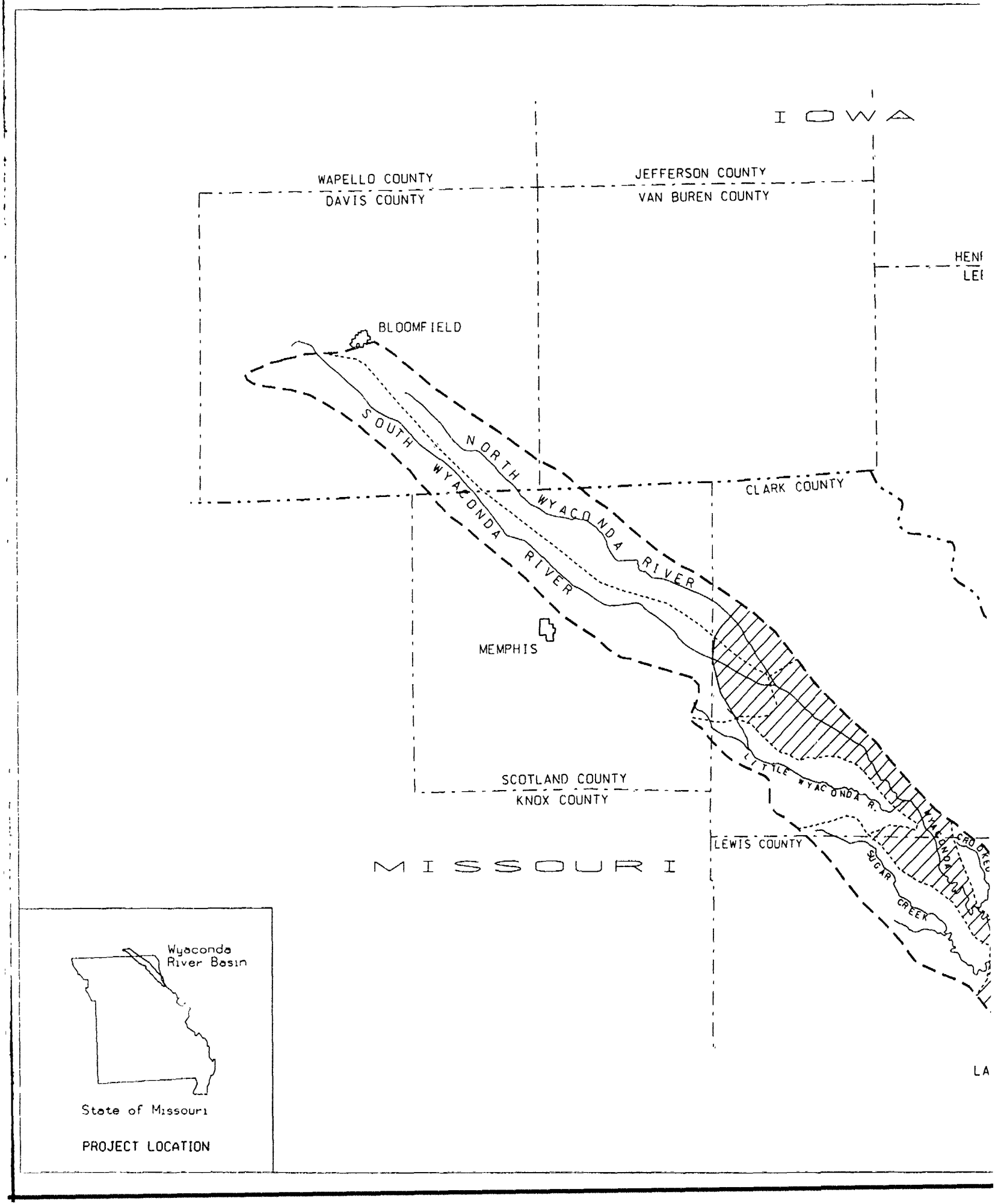
A *Notice of Study Progress* was mailed to the Wyaconda distribution list on July 17, 1991, that discussed study progress, the open house results, and the remainder of the work involved in the reconnaissance study phase. A copy of the notice is included in Appendix C-Pertinent Correspondence.

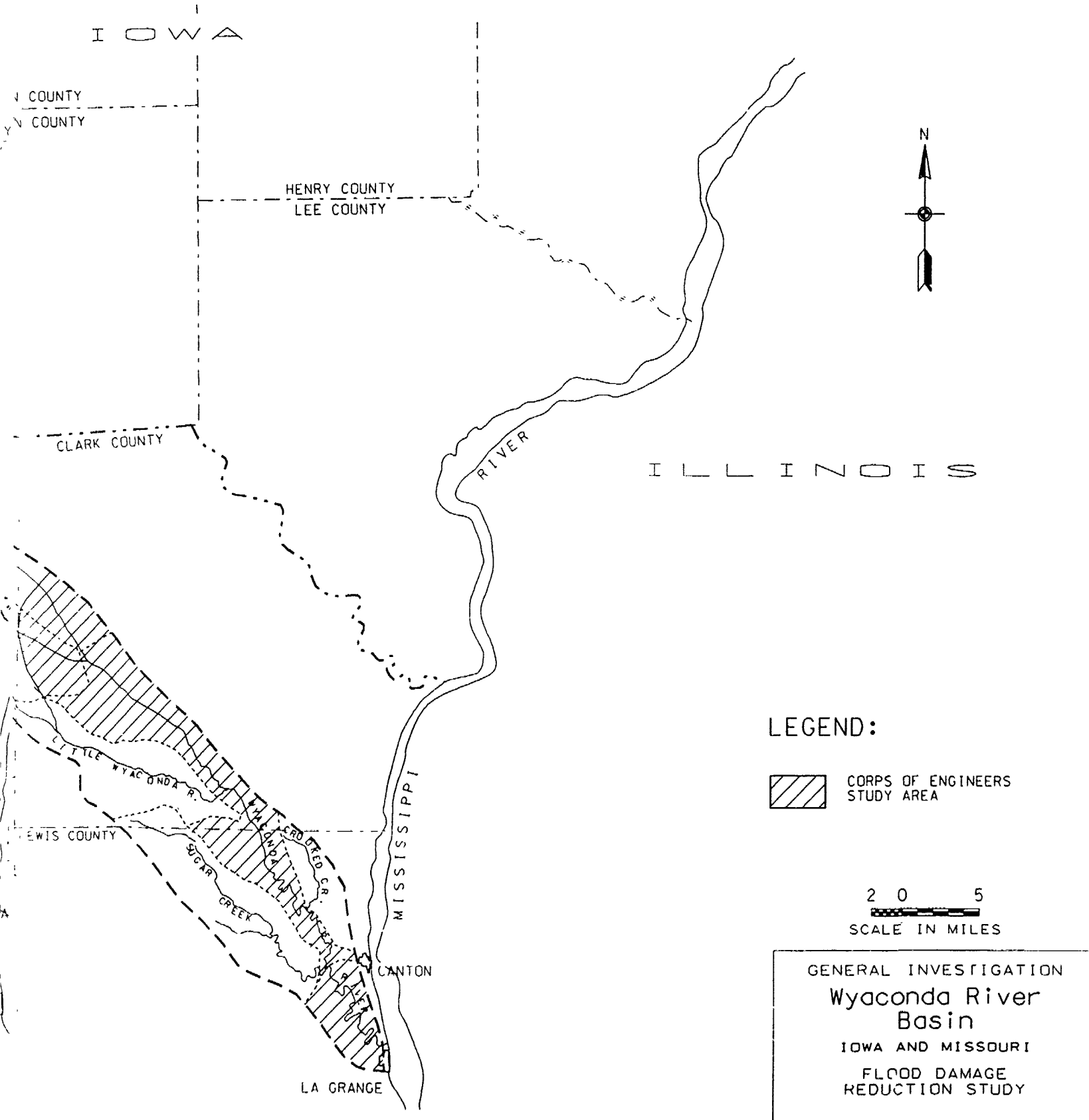
SECTION 4 - RECOMMENDATION

I recommend that the study conducted to determine the feasibility of measures for flood control and other water-related purposes in the Wyaconda River basin, Missouri, with particular reference to Clark and Lewis Counties, Missouri, be terminated. The study lacks economic justification for a broad range of alternatives. Some Wyaconda River subbasins' water resource needs may be best addressed by the U.S. Department of Agriculture-Soil Conservation Service under the authority of Public Law 83-566, the Watershed Protection and Flood Prevention Act.

John R. Brown
Colonel, U.S. Army
District Engineer

REVISED MARCH 1992


IOWA
WAPELLO COUNTY
DAVIS COUNTY
JEFFERSON COUNTY
VAN BUREN COUNTY
BLOOMFIELD
SOUTH WYACONDA RIVER
NORTH WYACONDA RIVER
CLARK COUNTY
MEMPHIS
SCOTLAND COUNTY
KNOX COUNTY
LEWIS COUNTY
LITTLE WYACONDA R.
SUGAR CREEK
MISSOURI
Wyaconda River Basin
State of Missouri
PROJECT LOCATION



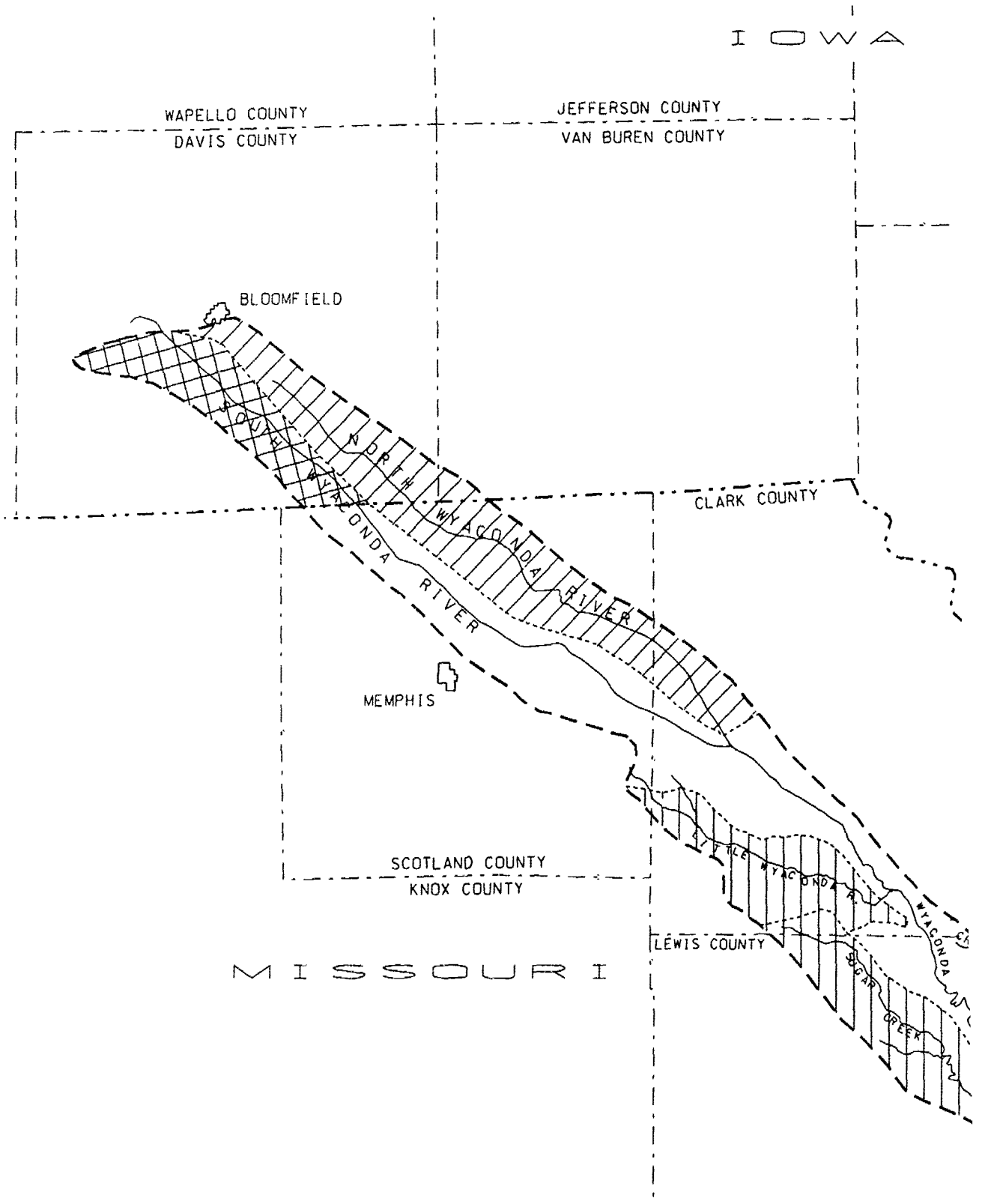
GENERAL INVESTIGATION

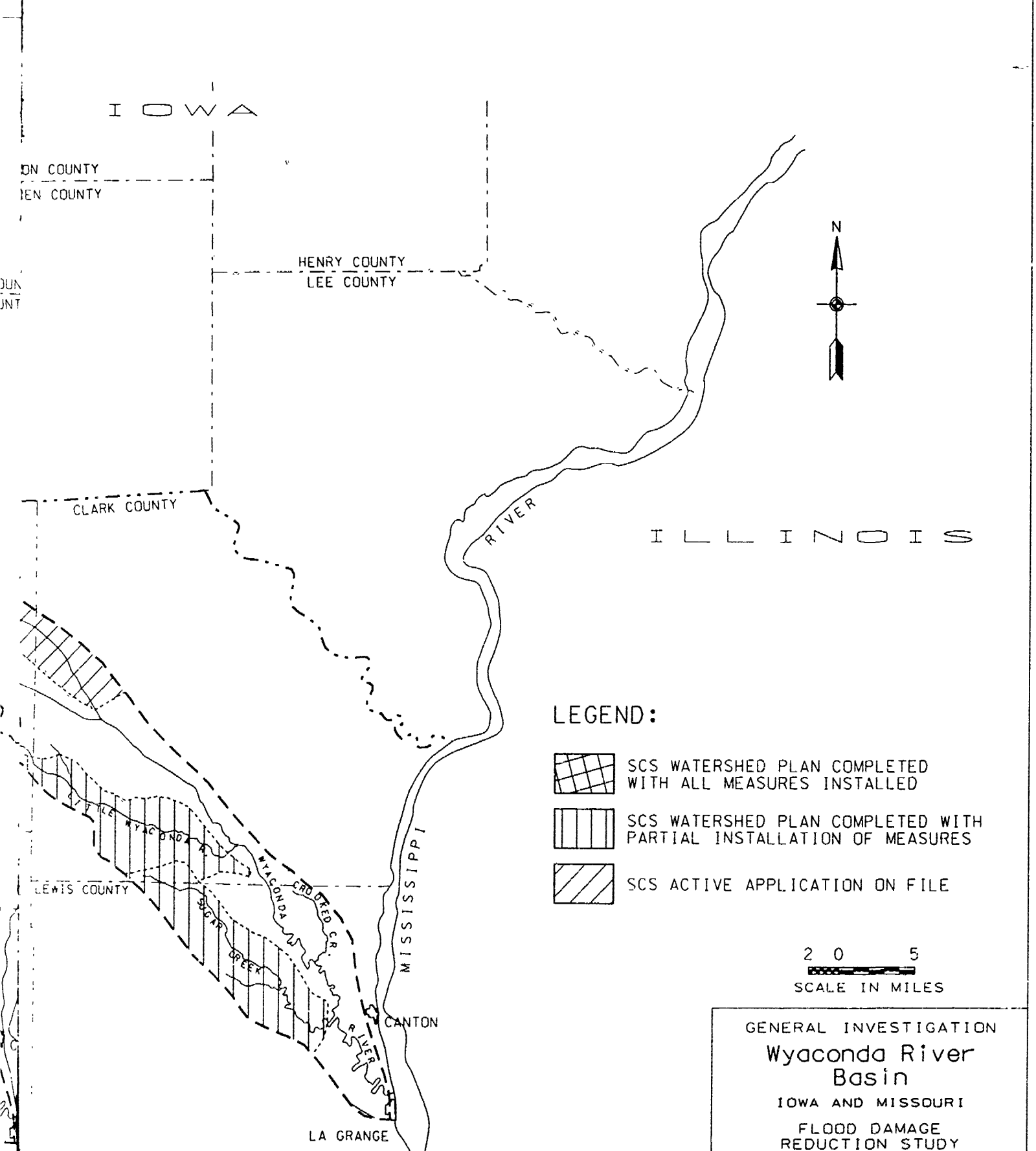
Wyaconda River Basin

IOWA AND MISSOURI

FLOOD DAMAGE REDUCTION STUDY

STUDY AREA


IOWA
WAPELLO COUNTY
DAVIS COUNTY
JEFFERSON COUNTY
VAN BUREN COUNTY
BLOOMFIELD
NORTH WYACONDA RIVER
SOUTH WYACONDA RIVER
CLARK COUNTY
MEMPHIS
SCOTLAND COUNTY
KNOX COUNTY
LEWIS COUNTY
LITTLE WYACONDA R.
WYACONDA CR.
SUGAR CREEK
MISSOURI



GENERAL INVESTIGATION

Wyaconda River Basin

IOWA AND MISSOURI

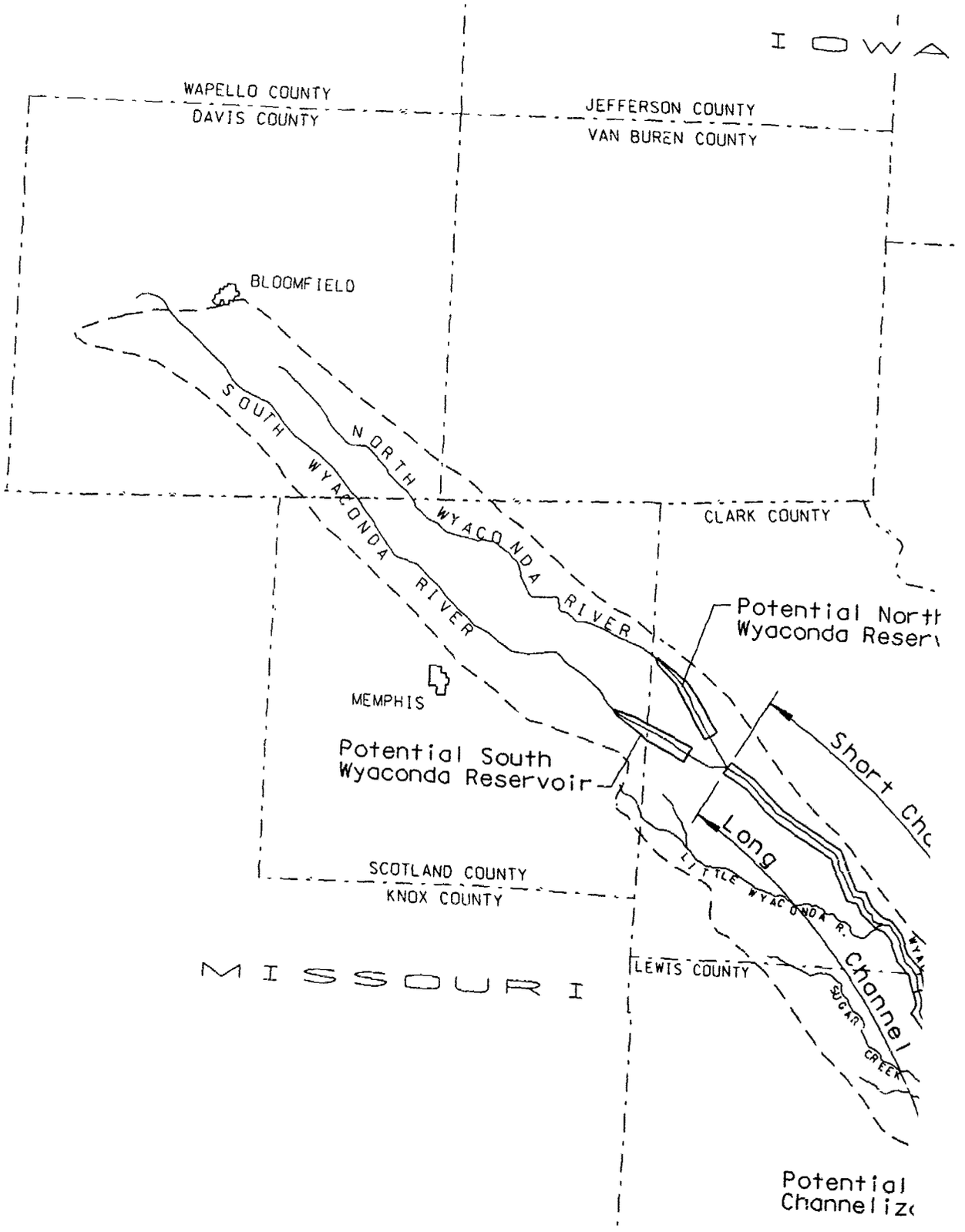
FLOOD DAMAGE REDUCTION STUDY

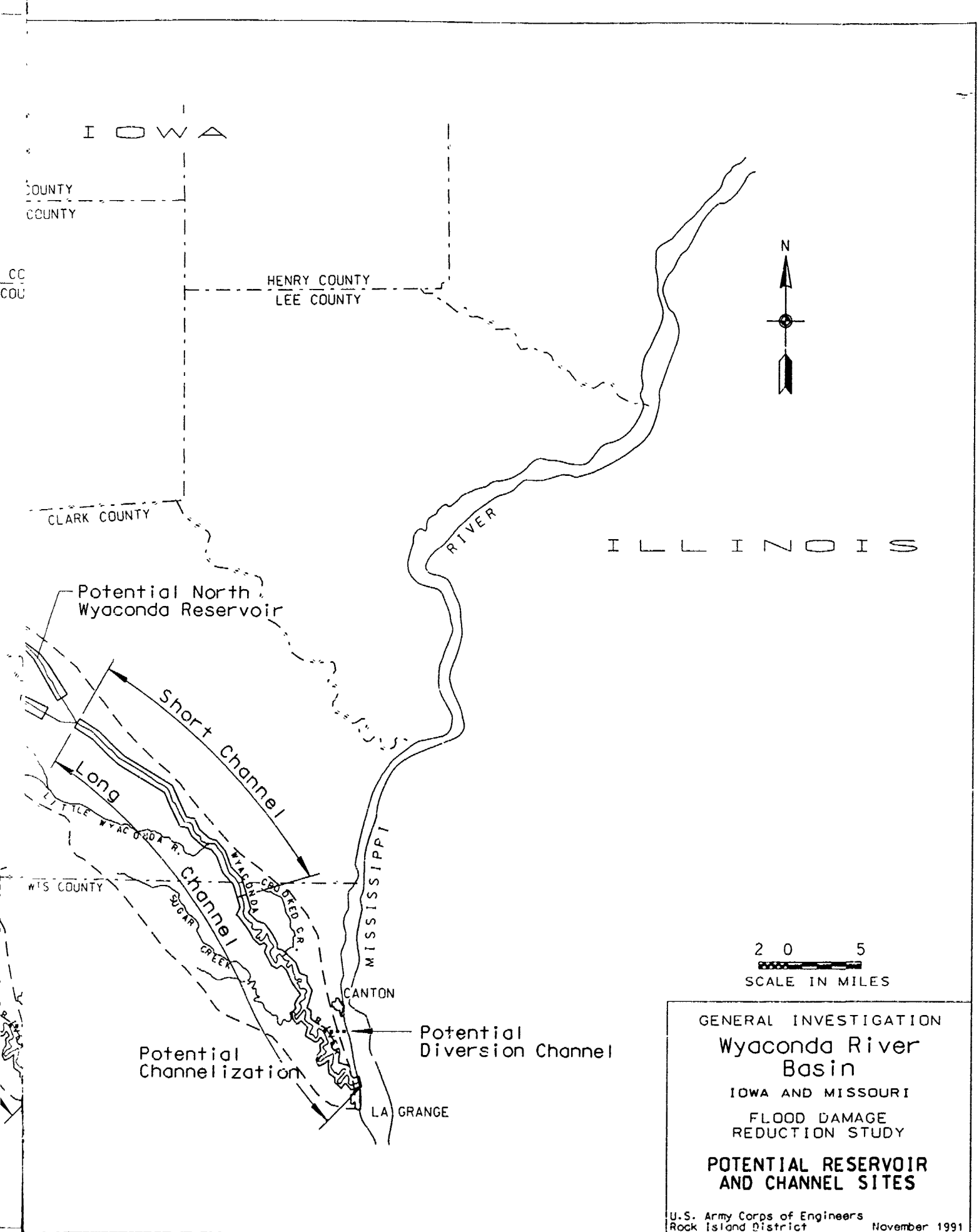
USDA SOIL CONSERVATION SERVICE BASIN STUDY AREAS

U.S. Army Corps of Engineers
Rock Island District

November 1991

PLATE 2


IOWA
WAPELLO COUNTY
DAVIS COUNTY
JEFFERSON COUNTY
VAN BUREN COUNTY
BLOOMFIELD
SOUTH WYACONDA RIVER
NORTH WYACONDA RIVER
CLARK COUNTY
Potential North
Wyaconda Reser
MEMPHIS
Potential South
Wyaconda Reservoir
Short Cha
Long
LITTLE WYACONDA R.
SCOTLAND COUNTY
KNOX COUNTY
MISSOURI
LEWIS COUNTY
Channel
SUGAR CREEK
Potential
Channeliz



GENERAL INVESTIGATION

Wyaconda River Basin

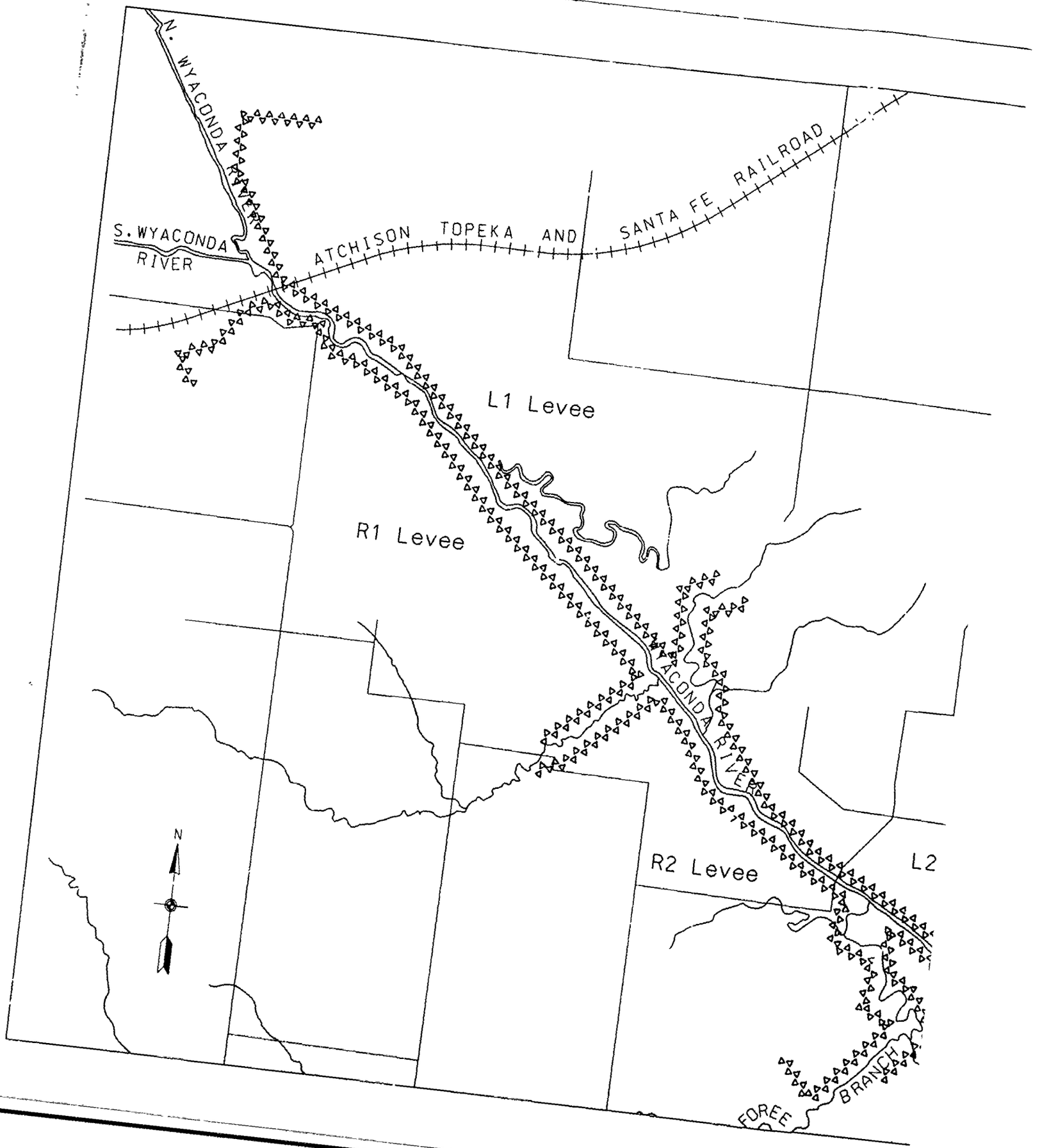
IOWA AND MISSOURI

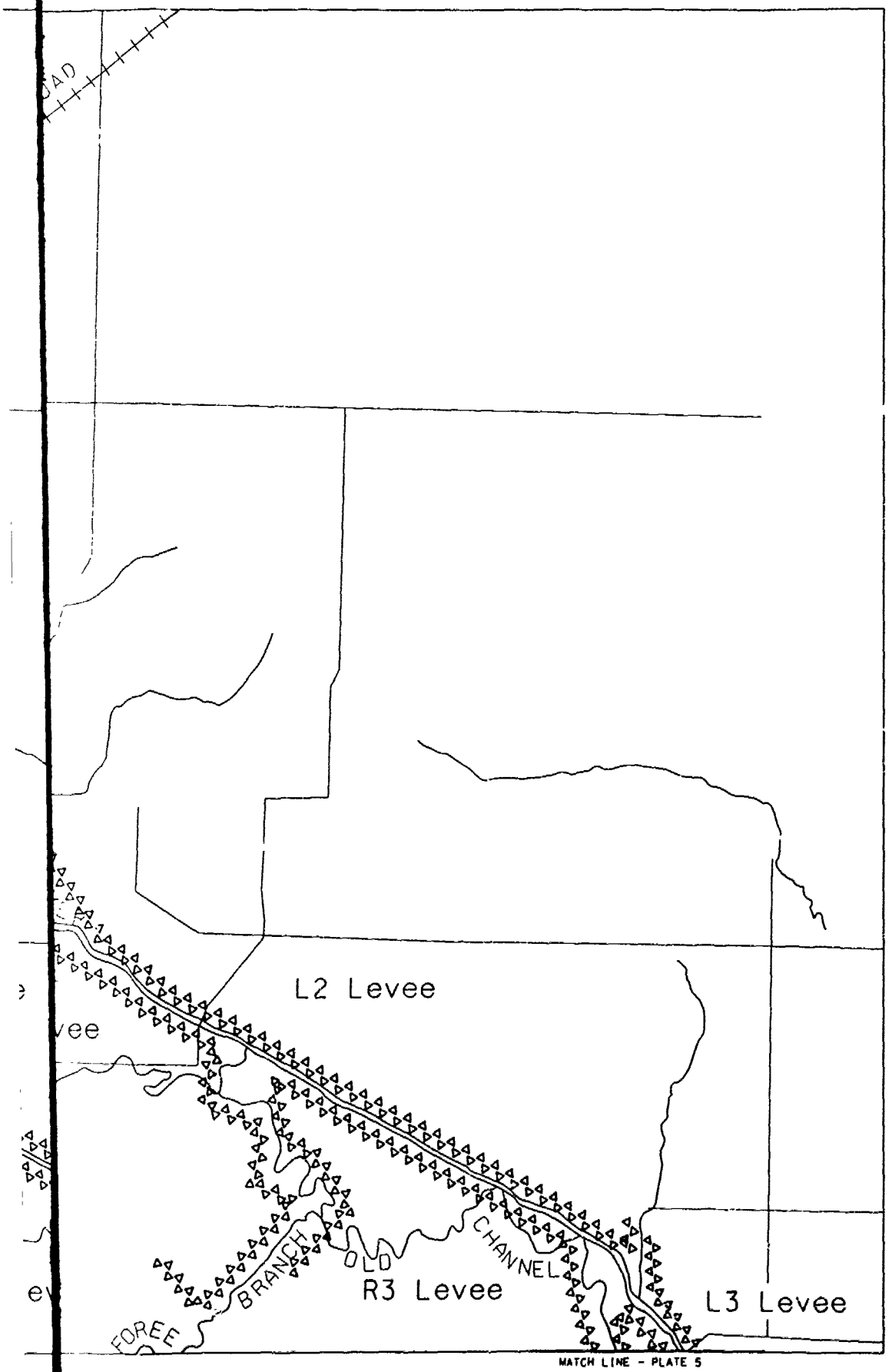
FLOOD DAMAGE REDUCTION STUDY

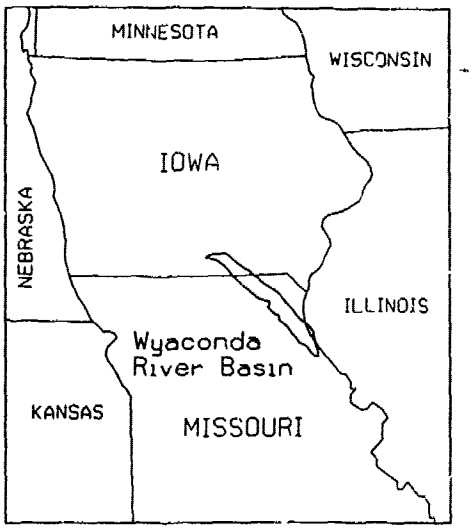
POTENTIAL RESERVOIR AND CHANNEL SITES

U.S. Army Corps of Engineers
Rock Island District
November 1991

PLATE 3


N. WYACONDA RIVER
S. WYACONDA RIVER
ATCHISON TOPEKA AND SANTA FE RAILROAD
L1 Levee
R1 Levee
R2 Levee
L2
N
FOREE BRANCH





VICINITY MAP

50 0 100

SCALE IN MILES

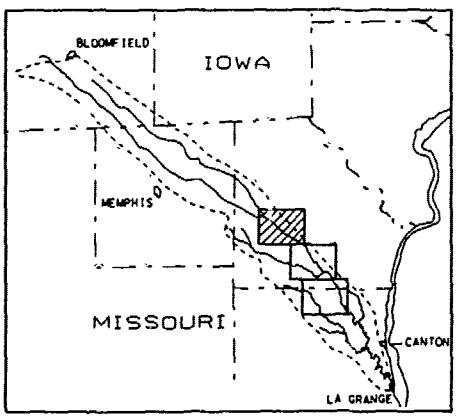


PLATE INDEX

KEY:

PROPOSED LEVEE

SECONDARY ROAD

2000' 0 3000'

SCALE IN FEET

GENERAL INVESTIGATION

Wyaconda River Basin

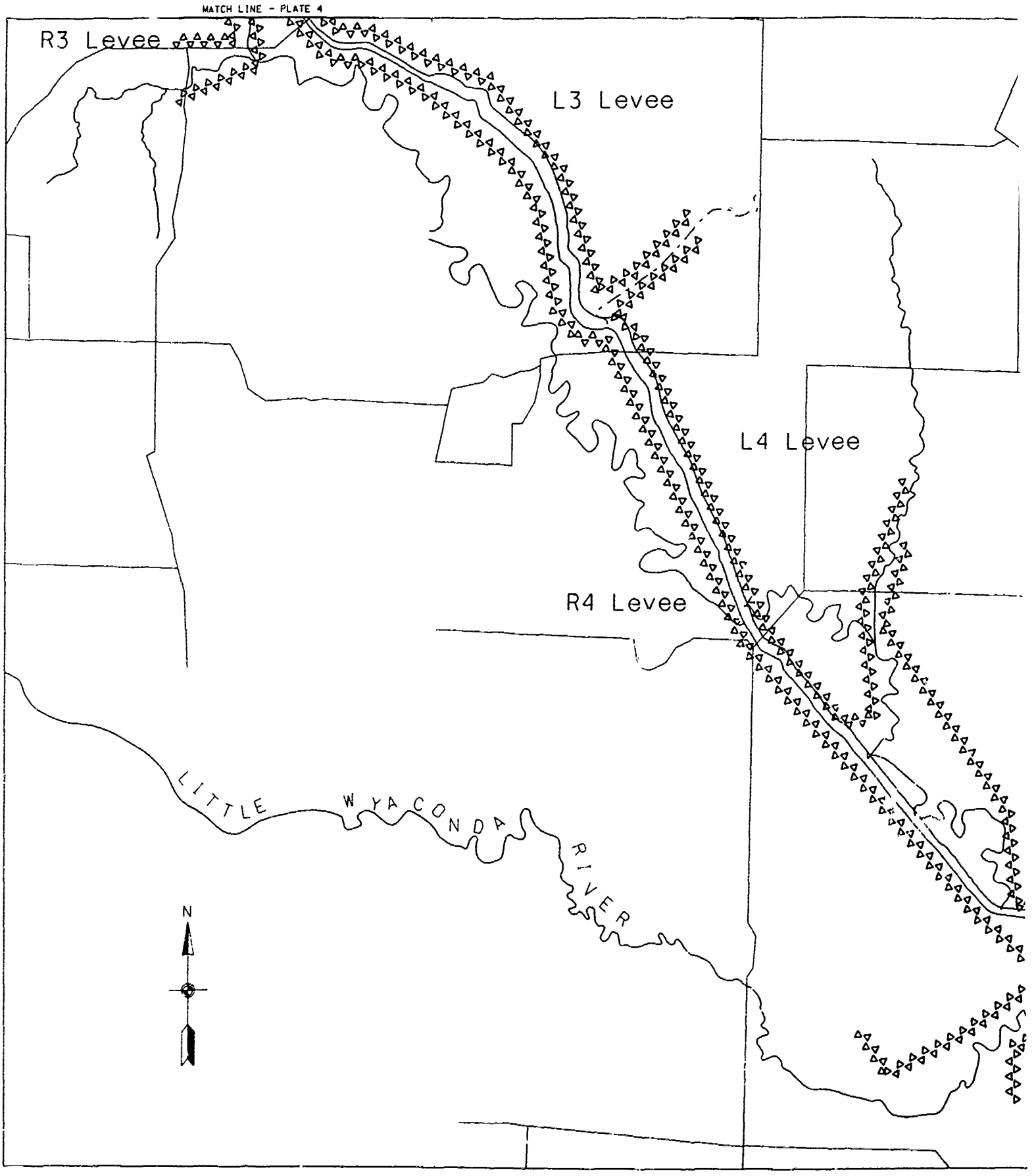
IOWA AND MISSOURI

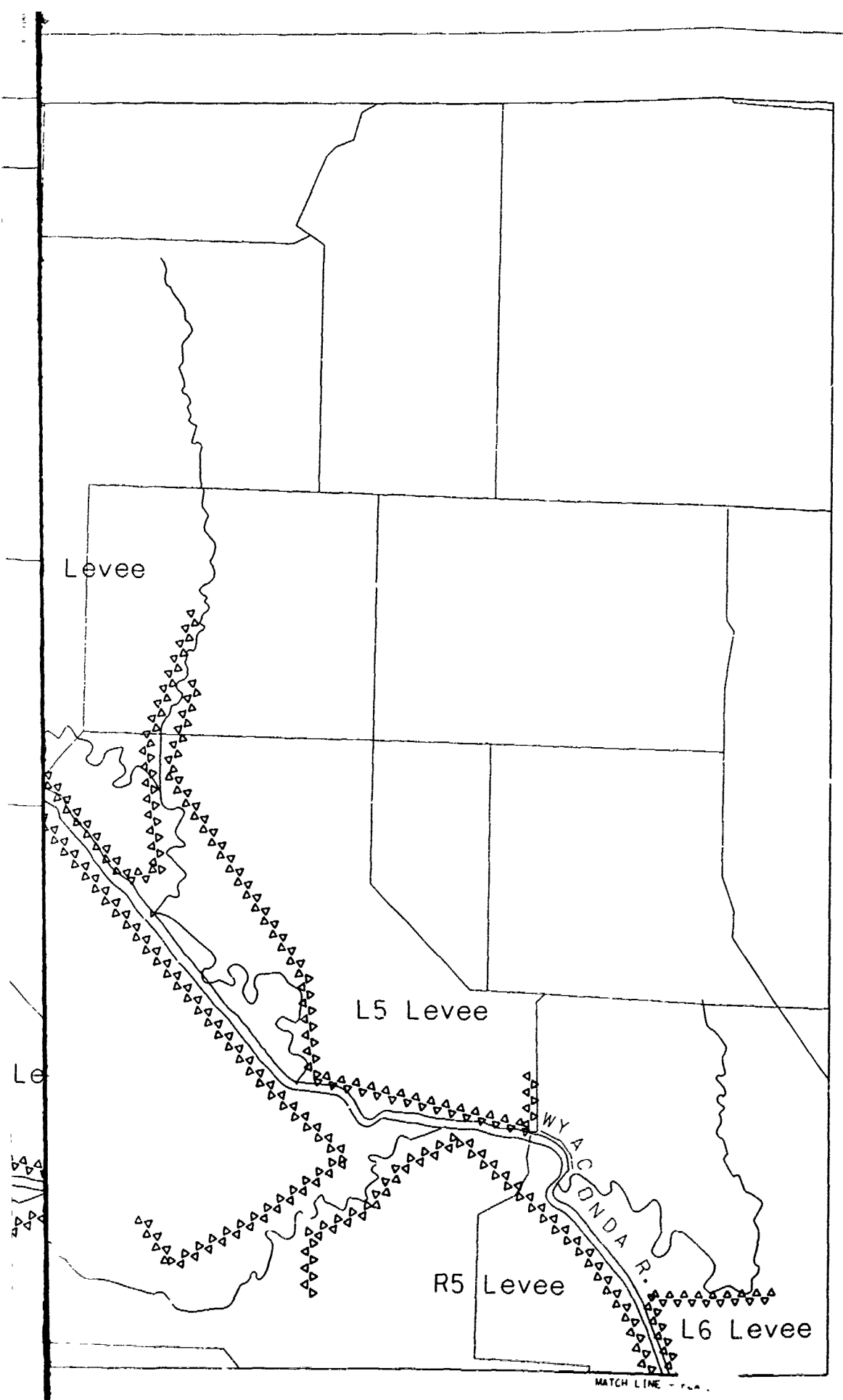
FLOOD DAMAGE REDUCTION STUDY

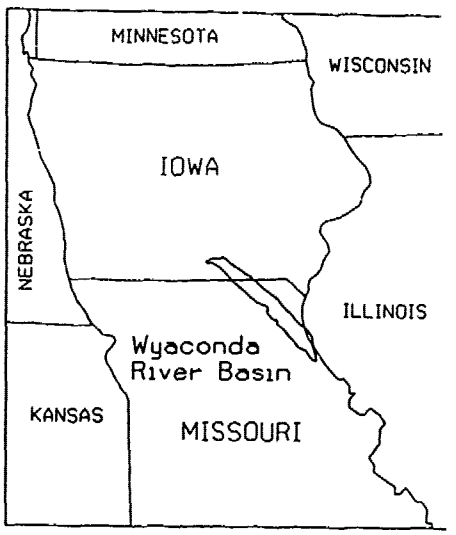
POTENTIAL LEVEE SITES I

U.S. Army Corps of Engineers
Rock Island District

November 1991


MATCH LINE - PLATE 4
R3 Levee
L3 Levee
L4 Levee
R4 Levee
LITTLE WYACONDA RIVER
N





VICINITY MAP

50 0 100

SCALE IN MILES

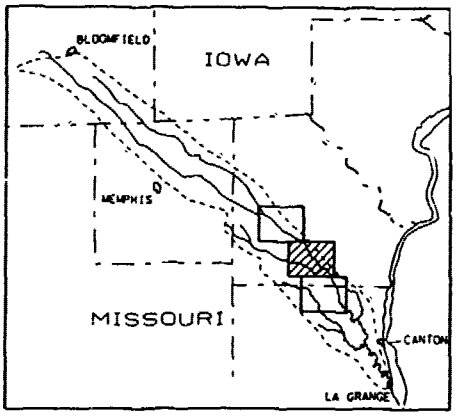


PLATE INDEX

KEY:

PROPOSED LEVEE

SECONDARY ROAD

2000' 0 3000'

SCALE IN FEET

GENERAL INVESTIGATION

Wyaconda River Basin

IOWA AND MISSOURI

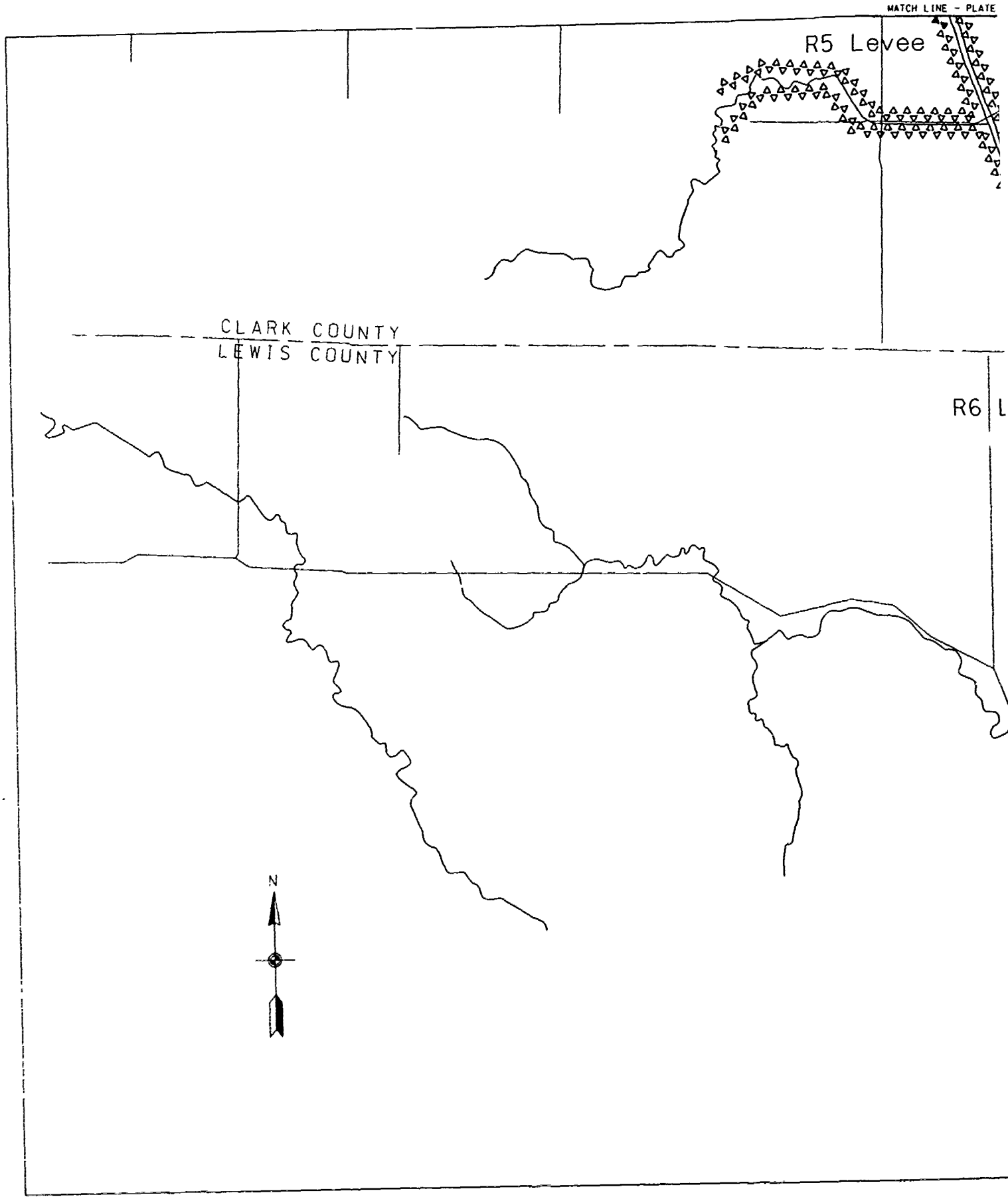
FLOOD DAMAGE REDUCTION STUDY

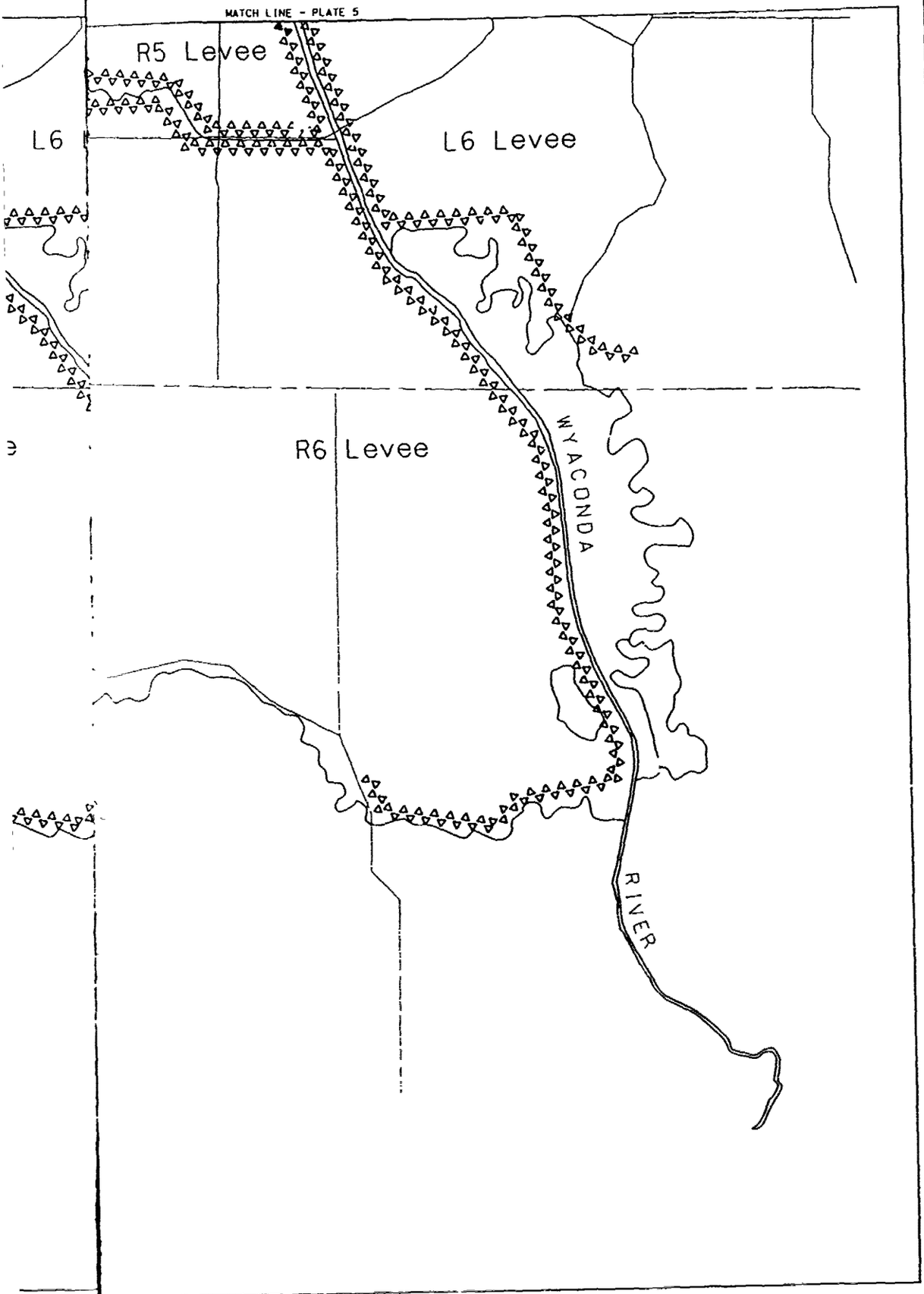
POTENTIAL LEVEE SITES II

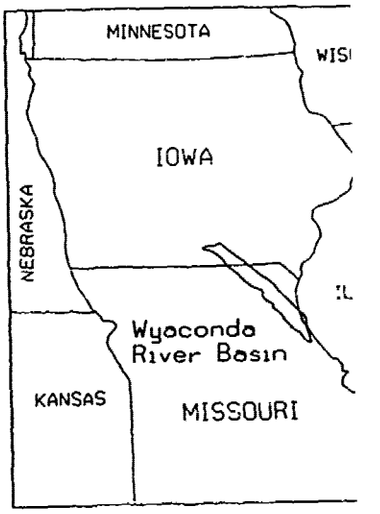
U.S. Army Corps of Engineers
Rock Island District

November 19

PLATE


MATCH LINE - PLATE
R5 Levee
CLARK COUNTY
LEWIS COUNTY
R6
N





VICINITY MAP

50 0 100

SCALE IN MILES

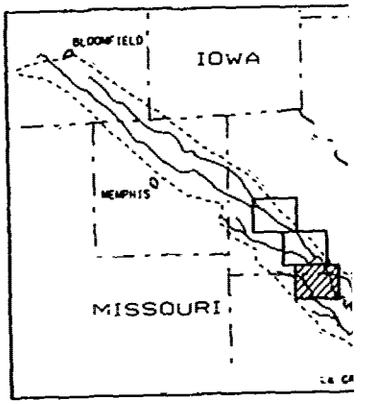


PLATE INDEX

KEY:

PROPOSED LEV

SECONDARY RC

2000' 0

SCALE IN FEE

GENERAL INVESTIG

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FLOOD DAMAGE
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POTENTIAL LEVEE SI

U.S. Army Corps of Engineers
Rock Island District

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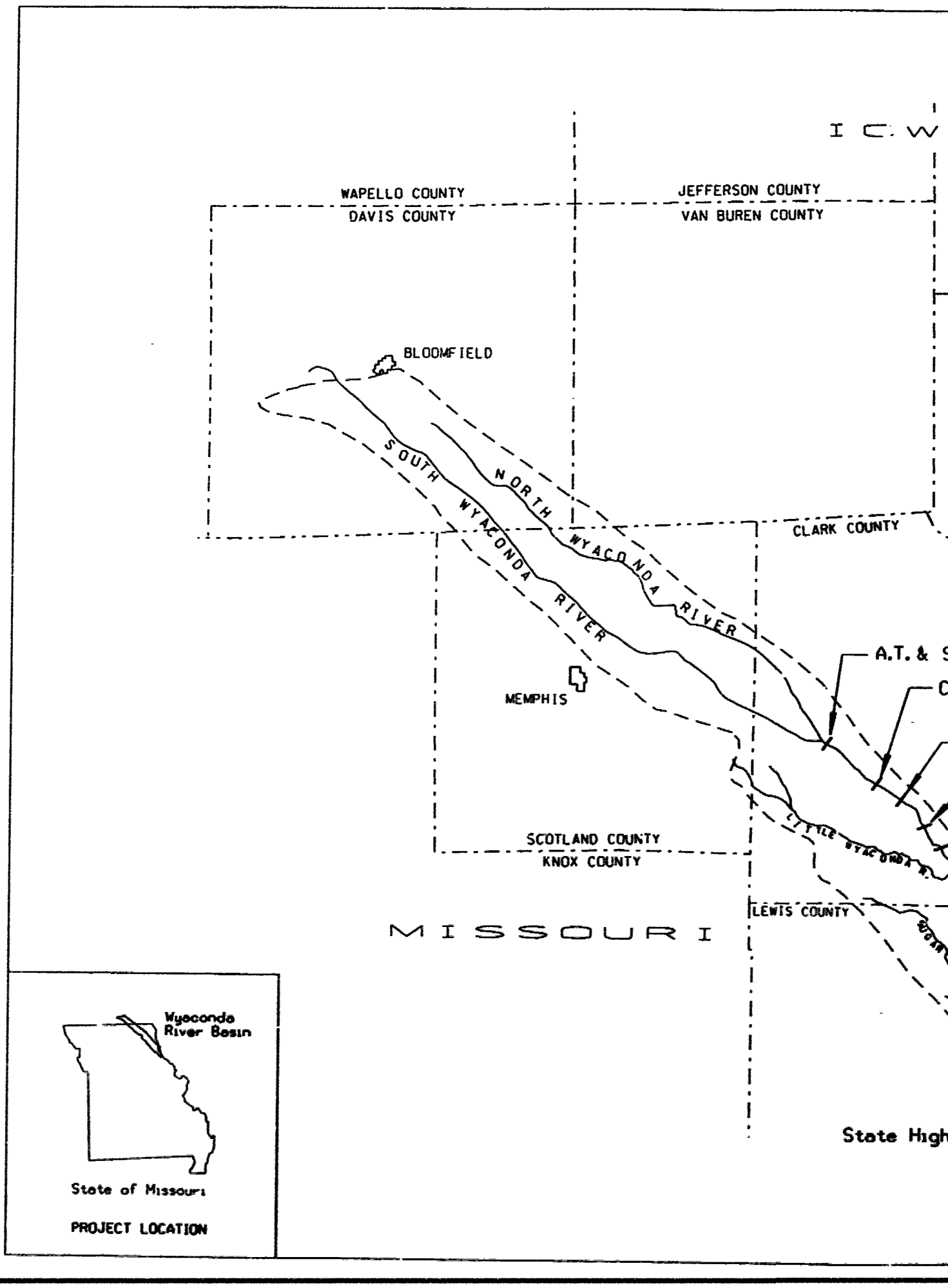
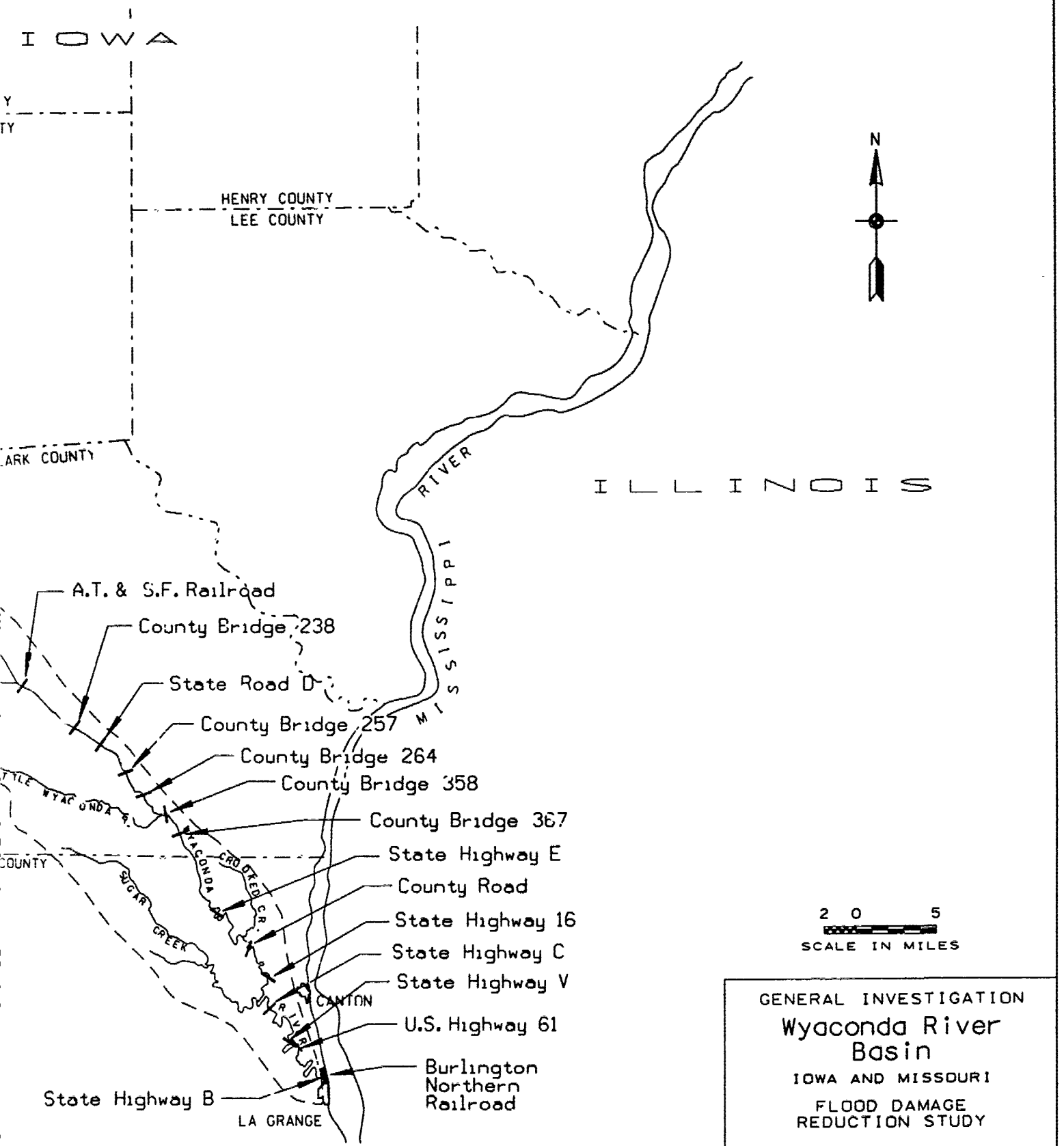

WAPELLO COUNTY
DAVIS COUNTY
JEFFERSON COUNTY
VAN BUREN COUNTY
BLOOMFIELD
SOUTH WYACONDA RIVER
NORTH WYACONDA RIVER
CLARK COUNTY
MEMPHIS
SCOTLAND COUNTY
KNOX COUNTY
LEWIS COUNTY
MISSOURI
Wyaconda River Basin
State of Missouri
PROJECT LOCATION



GENERAL INVESTIGATION

Wyaconda River Basin

IOWA AND MISSOURI

FLOOD DAMAGE REDUCTION STUDY

BRIDGES ON THE WYACONDA RIVER

U.S. Army Corps of Engineers
Rock Island District

November 1991

PLATE 7

HYDROLOGY AND HYDRAULICS

APPENDIX A

RECONNAISSANCE REPORT
FLOOD CONTROL AND OTHER WATER-RELATED PURPOSES
WYACONDA RIVER BASIN, MISSOURI AND IOWA

APPENDIX A
HYDROLOGY & HYDRAULICS

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Wyaconda Basin	A-1
General	A-2
Flood Frequency	A-2
Water Surface Profiles	A-2
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A-2	Wyaconda River at Canton, Missouri, Flow Frequency	A-2

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No.	Title
A-1	Flow Frequency Analysis
A-2 thru A-9	Flood Profiles, Wyaconda River

RECONNAISSANCE REPORT
FLOOD CONTROL AND OTHER WATER-RELATED PURPOSES
WYACONDA RIVER BASIN, MISSOURI AND IOWA

APPENDIX A
HYDROLOGY & HYDRAULICS

GENERAL

SITE LOCATION

The Wyaconda River basin is located in southeastern Iowa and northeastern Missouri. The North and South Wyaconda Rivers begin just south of Bloomfield, Iowa, and run southeast through Davis County, Iowa, and Scotland County, Missouri, before converging to form the Wyaconda River in Clark County, Missouri. From there, the river flows through Lewis County where it enters the Mississippi River near La Grange, Missouri. The Wyaconda basin has a drainage area of 458 square miles. Plate 1 in the main report shows the project location.

CLIMATOLOGY

The climate of the area is typically continental with changeable weather and a wide range of temperature extremes. Table A-1 summarizes the climate of four stations in the immediate vicinity of the Wyaconda basin: Bloomfield, Iowa, just to the north; Memphis, Missouri, to the west; Kahoka, Missouri, to the east; and Canton, Missouri, near the mouth.

TABLE A-1

Climate

Location	Average Snowfall (inches)	Average Precip (inches)	Max Avg High Temp (deg F/month)	Min Avg Low Temp (deg F/month)
Bloomfield	27.25	35.61	88 in Jul	13 in Jan
Memphis	25.07	34.35	89 in Jul	13 in Jan
Kahoka	24.51	37.44	88 in Jul	13 in Jan
Canton	22.93	36.39	88 in Jul	16 in Jan

WYACONDA BASIN

GENERAL

The Wyaconda basin is about 70 miles long and 8 miles wide, with a narrow floodplain bordered by rolling hills which become rolling prairies to form the divide with the adjacent watersheds. The tributary streams tend to be short and flow into the Wyaconda and its two main tributaries perpendicular to the channel. Approximately 67 miles of the Wyaconda and its north and south branches were straightened in the 1920's. The river is now showing some signs of reverting to its old meanders. The area is predominantly agricultural, featuring corn, soybeans, and pasture. Population is sparse. There are no occupied buildings within the floodplain.

FLOOD FREQUENCY

The Wyaconda River has a U.S. Geological Survey (USGS) gage at Canton, Missouri (49600) with a continuous record from 1923 through 1988, except for 4 years in the mid-1970's (1973, 1974, 1975, and 1977), that was used in this study. The record at Canton was compared to and lengthened by the North Fabius River at Monticello, Missouri (49700) because 1973 had a record flow in this adjacent watershed. The resulting correlation was 93 percent, with an equivalent period of record of 66.5 years. Flow frequencies were calculated using Bulletin 17B (Reference A) methodology. The resulting flow frequency relationship was confirmed by the Missouri regression equations and an HEC-1 model. The flow frequency for Canton is shown in table A-2 and on plate A-1. This frequency curve was moved to key locations on the Wyaconda by means of the ratio of the square root of the drainage area.

TABLE A-2

Wyaconda River at Canton, Missouri
Flow Frequency

Exceedence Frequency (Percent)	Flow (cfs)
0.2	39,900
0.5	31,800
1.0	26,500
2.0	21,800
5.0	16,300
10.0	12,800
20.0	9,540

WATER SURFACE PROFILES

The hydraulic analysis for the study was conducted using the U.S Army Corps of Engineers HEC-2 Water Surface Profiles computer program (Reference B). The program uses the backwater computational procedure generally known as the Standard Step Method to calculate the water surface profiles. The profiles were calculated from the mouth of the Wyaconda to the confluence of the North and South Wyaconda Rivers. The analysis for this project used surveyed bridge openings and USGS 20-foot contour maps to develop cross sections and reach lengths. The channel roughness factors (Manning's "n") used in the hydraulic computation were chosen by engineering judgment based on field observations. For the Wyaconda River channel, the "n" values ranged from 0.035 to 0.04, and for the overbank area they ranged from 0 04 to 0.095, reflecting the changes from smooth grass and barren soil to heavily wooded areas. Profiles from historic flows compared favorably to the Canton gage readings. Computational flows compared favorably to the rating curve and design water surface elevations shown on bridge designs.

The water surface profiles for the 10-, 5-, 2-, 1-, 0.5-, and 0.2-percent floods are shown on plates A-2 through A-9. These profiles show pre-project conditions.

REFERENCES

A. Bulletin 17B; Guidelines for Determining Flood Flow Frequency; Interagency Advisory Committee on Water Data; U.S. Geological Survey, September 1981.

B. HEC-2 Water Surface Profiles, U.S. Army Corps of Engineers, Hydraulic Engineering Center, May 1984.

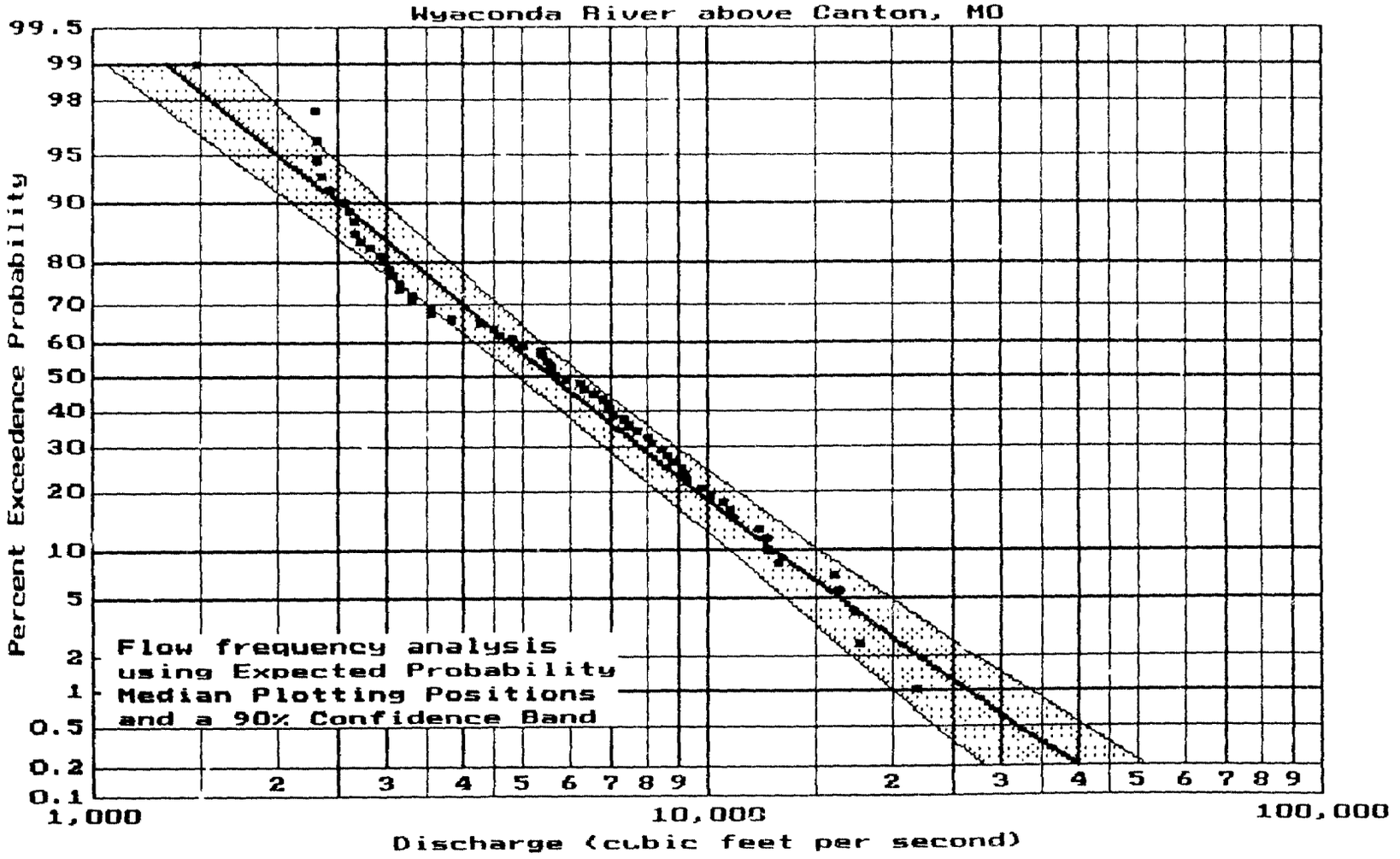

Wyaconda River above Canton, MO
Percent Exceedence Probability
99.5
99
98
95
90
80
70
60
50
40
30
20
10
5
2
1
0.5
0.2
0.1
Flow frequency analysis
using Expected Probability
Median Plotting Positions
and a 90% Confidence Band
2 3 4 5 6 7 8 9
1,000
2 3 4 5 6 7 8 9
10,000
100,000
Discharge (cubic feet per second)

PLATE A-1

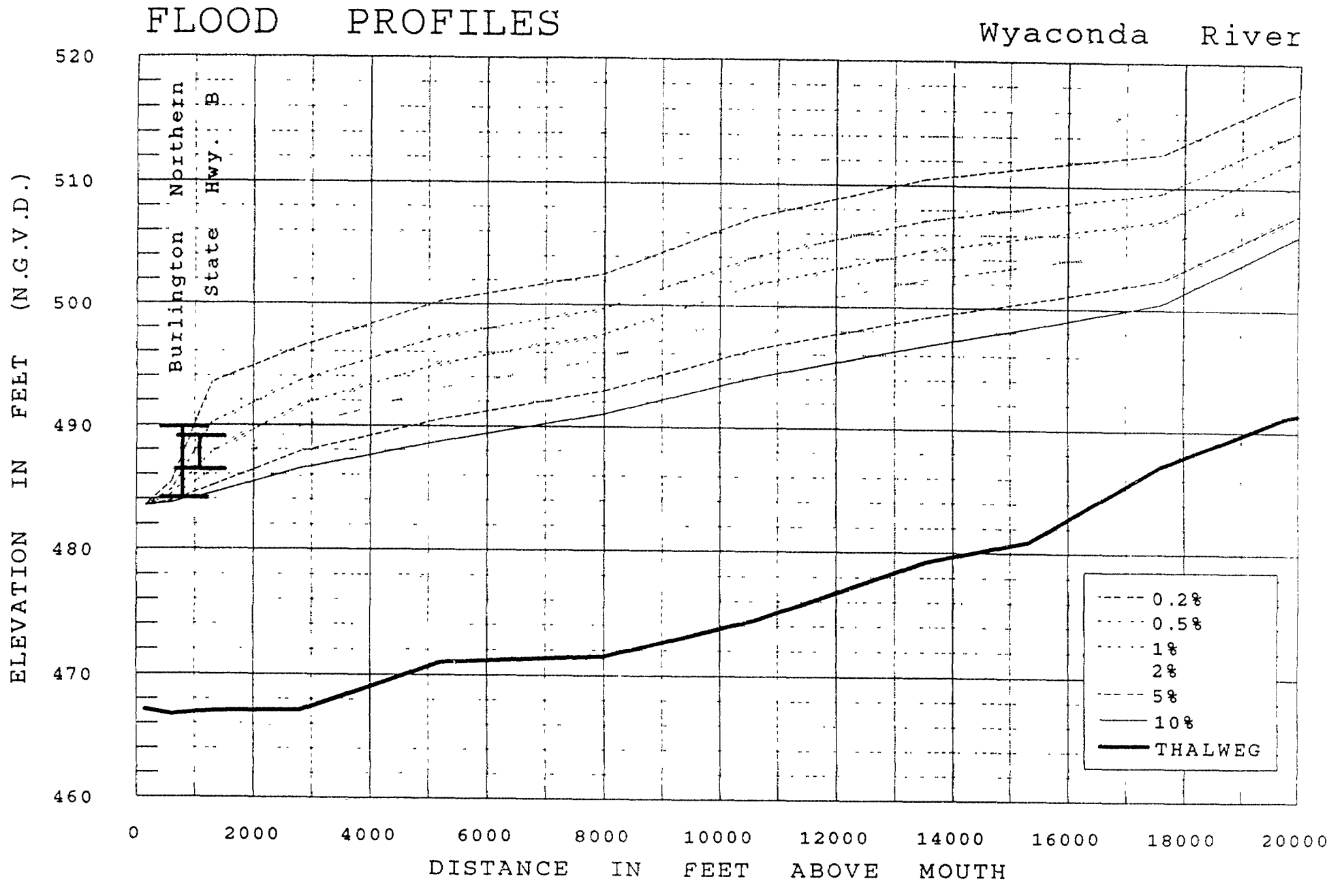

FLOOD PROFILES
Wyaconda River
Burlington Northern
State Hwy. B
ELEVATION IN FEET (N.G.V.D.)
520
510
500
490
480
470
460
0
2000
4000
6000
8000
10000
12000
14000
16000
18000
20000
DISTANCE IN FEET ABOVE MOUTH
0.2%
0.5%
1%
2%
5%
10%
THALWEG

PLATE A-2

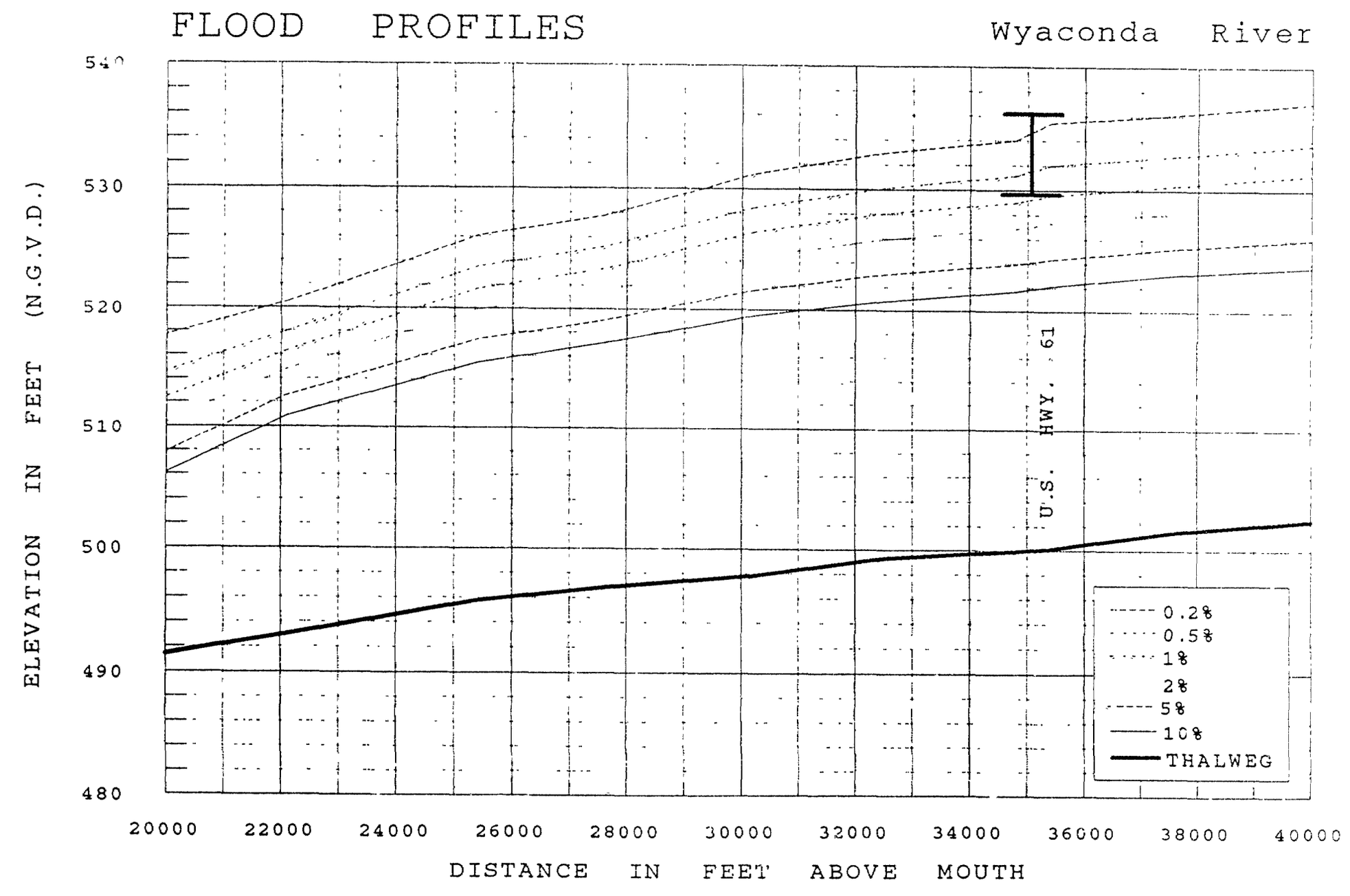

FLOOD PROFILES
Wyaconda River
ELEVATION IN FEET (N.G.V.D.)
540
530
520
510
500
490
480
20000
22000
24000
26000
28000
30000
32000
34000
36000
38000
40000
DISTANCE IN FEET ABOVE MOUTH
U.S. HWY. 61
0.2%
0.5%
1%
2%
5%
10%
THALWEG

PLATE A-3

FLOOD PROFILES

Wyaconda River

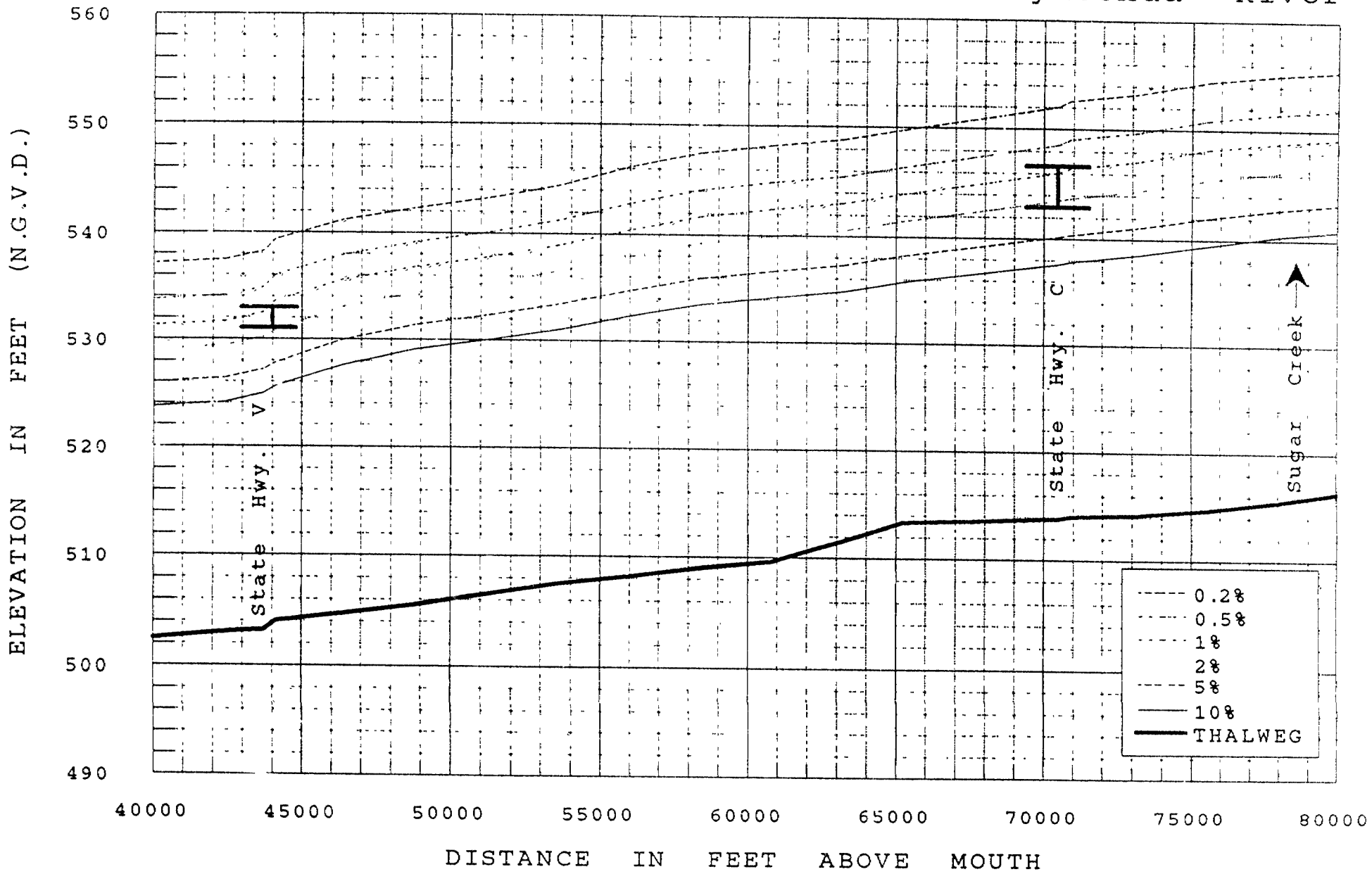


PLATE A

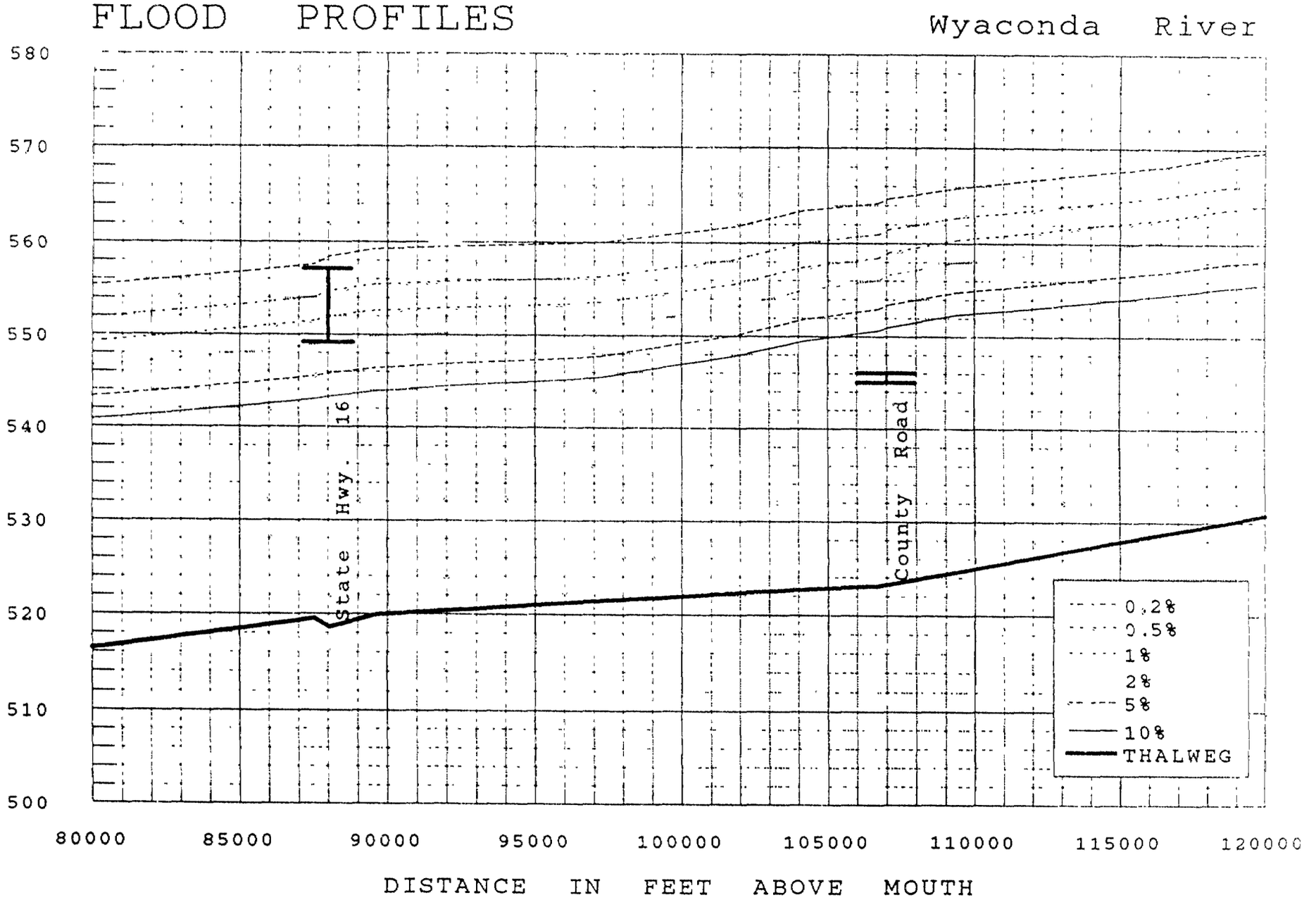
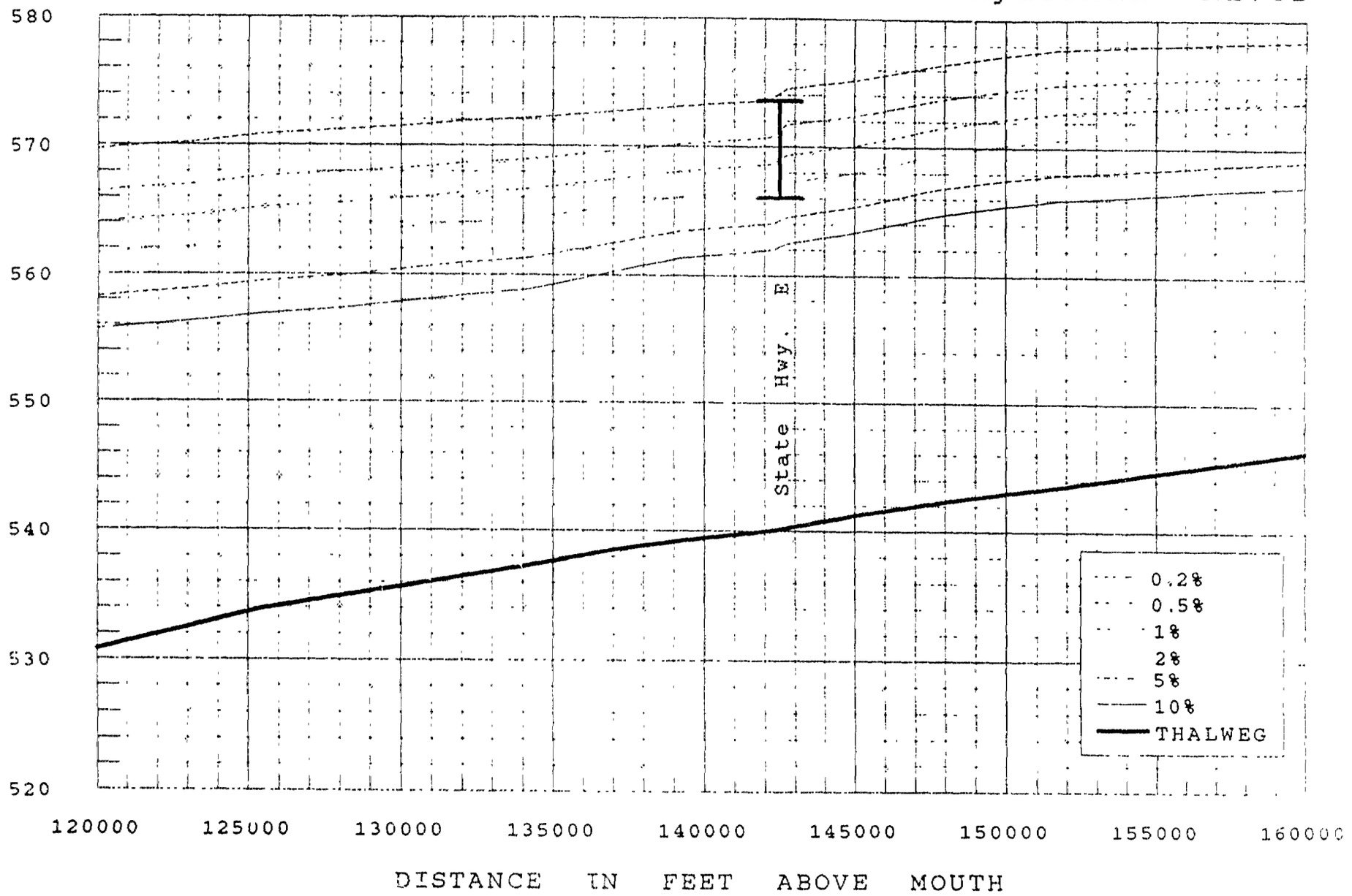

FLOOD PROFILES
Wyaconda River
ELEVATION IN FEET (N.G.V.D.)
580
570
560
550
540
530
520
510
500
80000
85000
90000
95000
100000
105000
110000
115000
120000
DISTANCE IN FEET ABOVE MOUTH
State Hwy. 16
County Road
0.2%
0.5%
1%
2%
5%
10%
THALWEG

PLATE A-5

FLOOD PROFILES

Wyaconda River



PLATE

FLOOD PROFILES

Wyaconda River

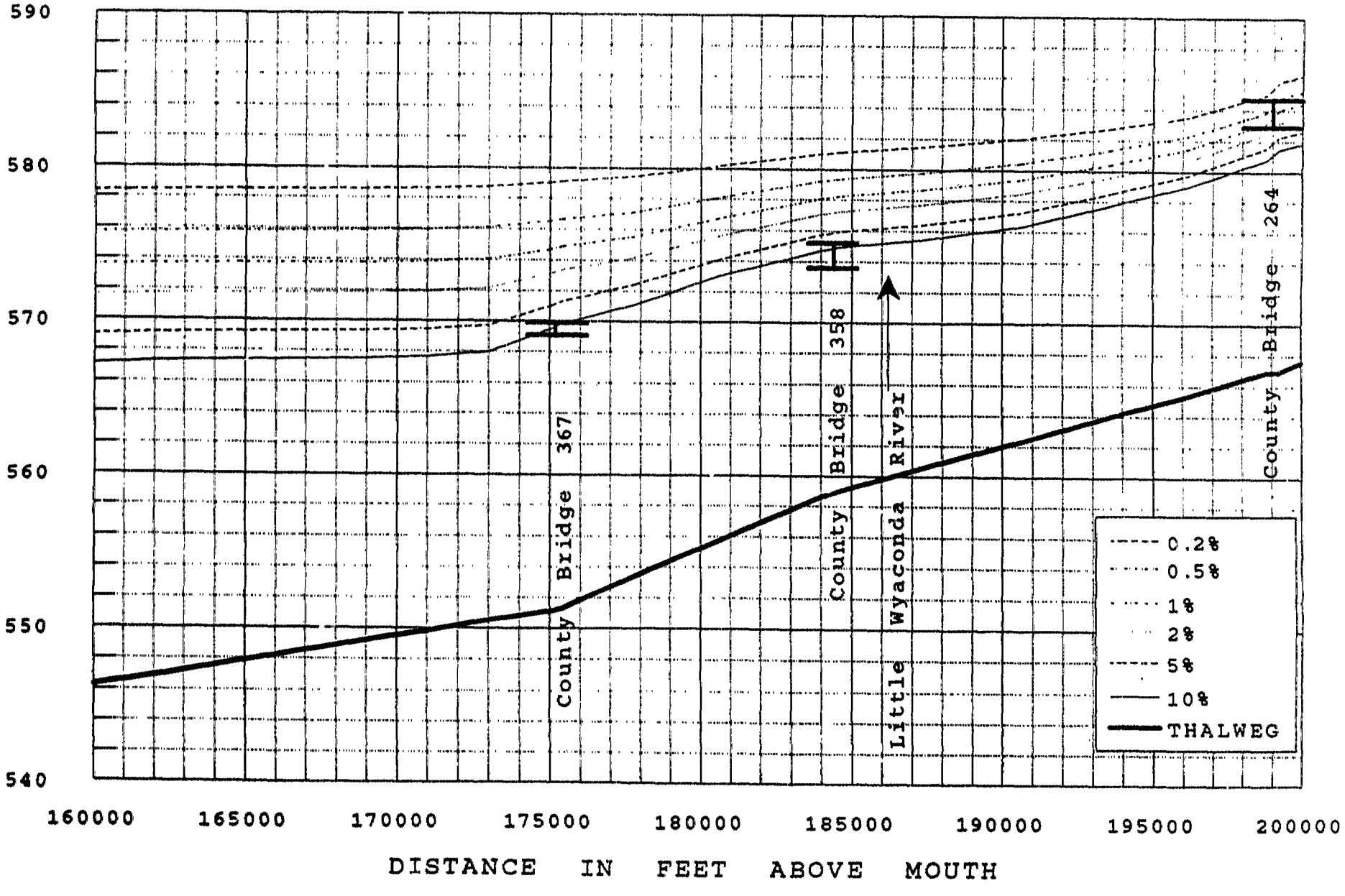


PLATE A-7

FLOOD PROFILES

Wyaconda River

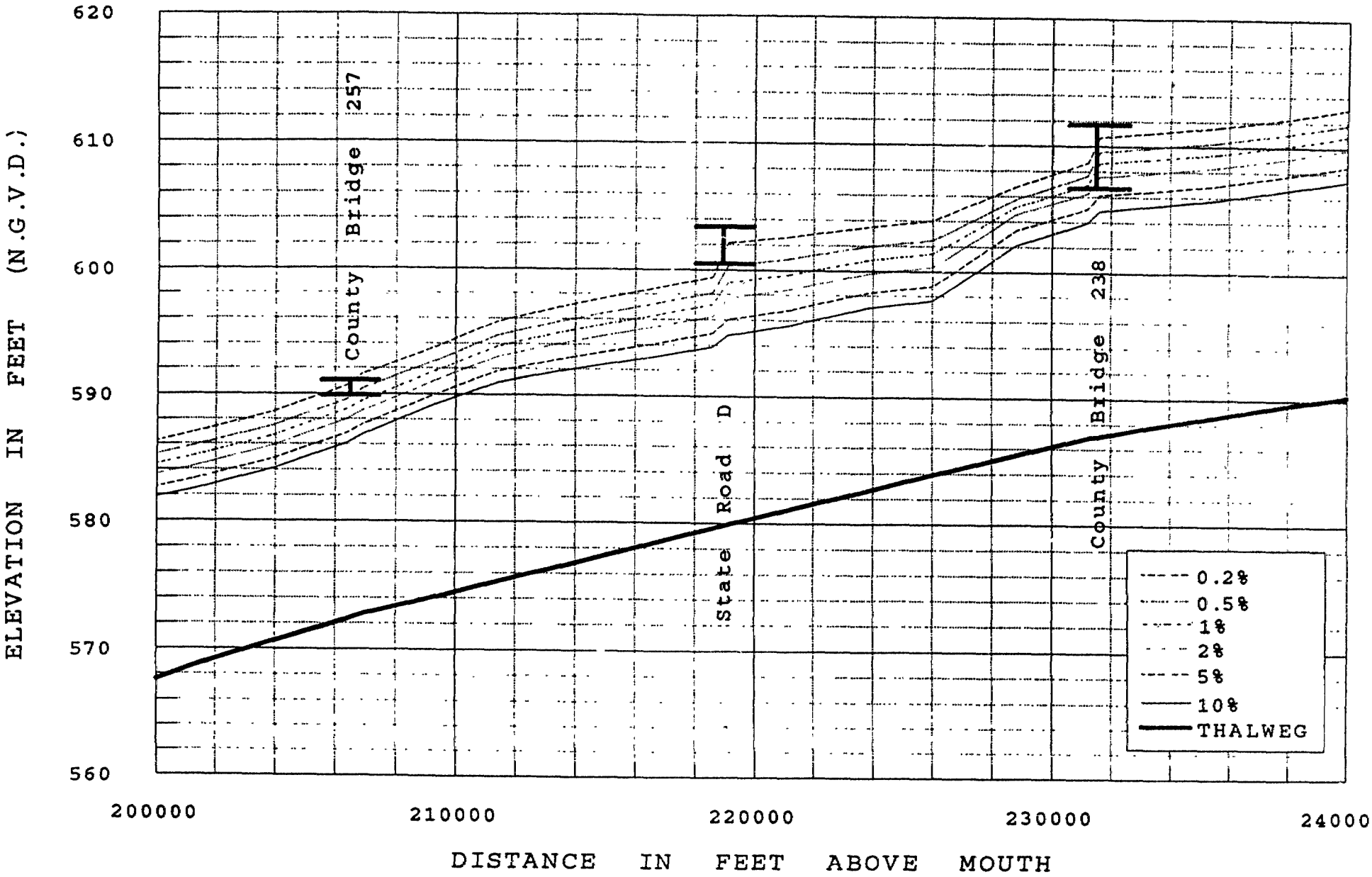
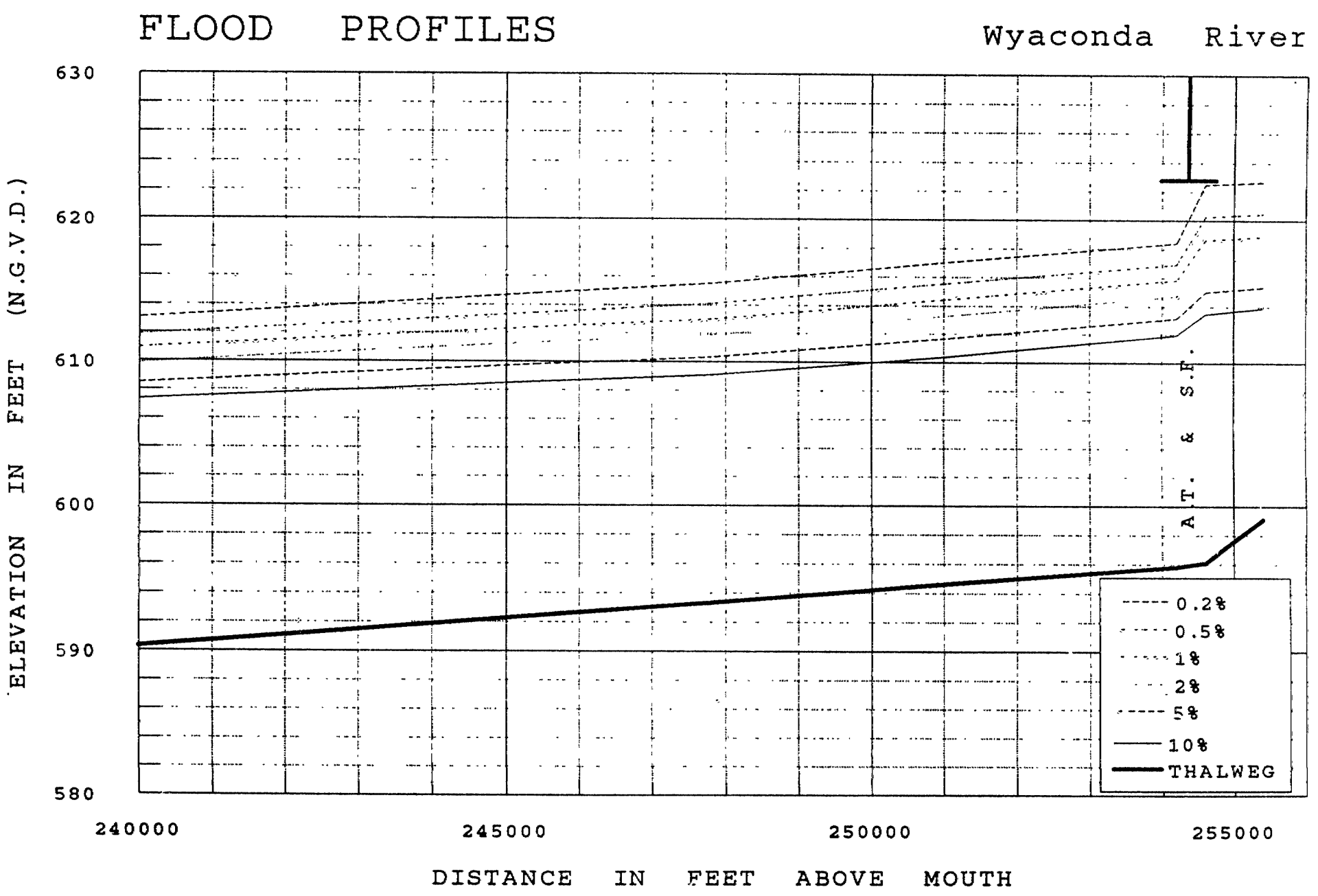


PLATE A-8


FLOOD PROFILES
Wyaconda River
630
620
610
600
590
580
ELEVATION IN FEET (N.G.V.D.)
240000
245000
250000
255000
DISTANCE IN FEET ABOVE MOUTH
A.T. & S.F.
0.2%
0.5%
1%
2%
5%
10%
THALWEG

A

P

P

E

N

ECONOMIC ANALYSIS

D

I

X

B

RECONNAISSANCE REPORT
FLOOD CONTROL AND OTHER WATER-RELATED PURPOSES
WYACONDA RIVER BASIN, MISSOURI AND IOWA

APPENDIX B
ECONOMIC ANALYSIS

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RECONNAISSANCE REPORT
FLOOD CONTROL AND OTHER WATER-RELATED PURPOSES
WYACONDA RIVER BASIN, MISSOURI AND IOWA

APPENDIX B
ECONOMIC ANALYSIS

STUDY AREA CHARACTERISTICS

GENERAL

The Wyaconda River basin is located within Davis and Van Buren Counties, Iowa, and Scotland, Clark, and Lewis Counties, Missouri. The basin covers a 458-square-mile area, is about 70 miles long, and is 8 miles wide at its widest point. The river headwaters are in Davis County, near Bloomfield, Iowa. The Wyaconda River flows southeasterly to the Mississippi River near La Grange, Missouri.

STUDY AREA

The study area begins directly after the confluence of the North and South Wyaconda Rivers into the Wyaconda River. The U.S. Department of Agriculture-Soil Conversation Service is and will be working on several projects located along the North and South Wyaconda Rivers and various creeks in the Wyaconda River basin under Public Law 83-566, the Watershed Protection and Flood Prevention Act.

SOCIO-ECONOMIC CONDITIONS

Four incorporated communities are within the Wyaconda River basin, all within Missouri: Arbela, Granger, Luray, and Wyaconda.

Communities located within less than 10 miles from the study project area include Memphis, Prospect Grove, Azen, Brock, Gorin, Ashton, Kahoka, Fairmont, Neeper, Antioch, St. Patrick, Williamstown, Benjamin, Monticello, Canton, and La Grange, Missouri. The nearest industrial centers in Iowa are Ottumwa (1985 pop. 27,381), approximately 20 miles north of Bloomfield; and Keokuk (1985 pop. 13,536), approximately 30 miles from the center of the basin. Hannibal, Missouri (1985 pop. 22,722), located approximately 20 miles west of the southern tip of the basin, is the nearest Missouri industrial center.

U.S. Highway 136, an east-west highway, traverses the northern portion of the basin. East-west Missouri Highway 16 traverses the southern tip of the basin. Missouri Highway 15, a north-south highway, traverses the northern portion of the basin. The Atchison, Topeka, and Santa Fe Railway crosses the Wyaconda and Little Wyaconda Rivers in Clark County, Missouri.

Table B-1 shows the comparative historic population for the four communities within the basin. County populations shown reflect an approximation of residents within the basin based upon the percentage of basin within the study area.

TABLE B-1

Population Trends

	Pop. 1960	Pop. 1970	Pop. 1980	Pop. 1990
Arbela	70	70	67	40
Granger	146	105	91	63
Luray	154	149	175	70
Wyaconda	402	356	359	347
Clark County	2,685	2,561	2,633	2,317
Lewis County	4,068	4,015	4,038	3,790

Source: United States Bureau of the Census.

Table B-2 presents the labor force data for the various communities within the study area. Employment is concentrated in agriculture, manufacturing, and professional and related services.

TABLE B-2

Labor Force Data

	Percent Distribution
Agriculture	32.2
Manufacturing	21.3
Professional and Related Services	17.6
Wholesale and Retail Trade	14.2
Construction and Transportation	10.5
Finance, Insurance, and Real Estate	2.4
All Other	1.8

Source: Claritis Corporation, *REZIDE 1985*, The National Encyclopedia of Residential ZIP Code Demography.

HISTORIC FLOODING

Historic flooding in the study area is detailed in the Appendix A-Hydrology and Hydraulics. The study area in Clark County was severely inundated by the 1986 flood, which was a 25-year frequency event. The basin valley is flat, and storms with a 2-year frequency can inundate farmlands, bridges, and roads in the basin. The September 1986 flood was the most recent major flood of record.

EXISTING CONDITIONS

There were no flooding problems in communities within or adjoining the study area. Overbank flooding inundates agricultural lands and causes crop and road damage, soil erosion, and silt deposition.

Numerous private agricultural levees, of varying design height, are located throughout the Wyaconda River floodplain, but no formalized flood control system exists. Most of the September 1986 flood damages were concentrated in the Clark County, Missouri, portion of the basin. The majority of the lands affected are in agricultural production. Floods generally occur during the crop-growing season, and ponding is of sufficient duration to destroy all affected crops. Because of the flooding duration, it is not possible or economically practical to attempt replanting.

FLOOD DAMAGES

METHODOLOGY

The economic analysis was performed in accordance with Public Law 89-80, Guidelines Sections III and IV.

The study area is defined as that area immediately or directly affected by the project. For purposes of analysis, the study area was separated into 12 separate reaches, 6 on each side of the Wyaconda River main stem (see plate 1 in the main report). An inventory of the study area was made in March 1991. The survey indicated there are no residential structures within the floodplain.

In computing flood damages, no credit was given to existing privately constructed levees. The plans examined for this study phase involved providing protection to the entire study area by constructing a diversion channel. Also analyzed were construction of individual levees for each of the 12 separate reaches to provide protection from the 10-, 100-, and 500-year flooding events.

AGRICULTURAL DAMAGES

An estimated 9,200 acres of cropped land are susceptible to inundation in the study area. Estimated cropping distribution is split between corn and soybeans. Damage per acre for the growing season was calculated by averaging the minimum and maximum potential damage which could occur during the growing season. Yield information was obtained from local farmers and county officials. Crop prices used were those required by regulation. A composite damage estimate was arrived at based on crop and damage value per acre. The composite damage per acre was multiplied by average annual acres flooded under with- and without-project conditions to determine average annual damages and benefits.

Table B-3 shows the average dollar damage analysis for corn grown in the Clark County. The estimated average annual damages for crop losses in the study area are $1,477,000.

TRANSPORTATION DAMAGES

In flood conditions, numerous county roads and bridges would be impassable or unreachable. Average daily traffic counts in 1990 for the six bridges in the study area were obtained and detour costs were determined. Four of the six bridges were constructed sometime around 1910, are low, and would necessitate that their normal traffic be detoured during high water stages.

Once overtopped, traffic would not be allowed on the bridges until after the water had receded and the ground had the opportunity to stabilize. It was assumed that, as a bridge becomes impassable, its traffic would divert to the closest bridge. Bridge elevations were taken from USGS quadrangle sheets. Frequencies for those elevations were derived from flood profiles in Appendix A-Hydrology and Hydraulics. Table B-4 shows the county bridges, their elevation, the flood frequency at which they would overtop, their daily traffic count, and the assumed bridge to which their traffic would detour.

Table B-3 Damage Value Per Acre - Corn

AVERAGE ANNUAL DAMAGES: CORN

PROJECT: WAYACONDA RIVER BASIN
STATE: MISSOURI COUNTY: CLARK

PRODUCTION PRICE LEVEL: Apr 91 YIELD / ACRE: 115.0 Bushels CURRENT NORMALIZED PRICE: 1.96 per Bushel

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SPT	OCT	NOV	DEC	TOTAL
Total Variable Costs (1)	0.74	0.74	0.74	24.12	96.47	30.14	4.84	0.67	13.93	13.93	9.52	0.74	196.58
Expended	0.74	1.48	2.21	26.33	122.80	152.95	157.79	158.45	172.39	186.32	195.84	196.58	
Unexpended	195.84	195.10	194.36	170.25	73.77	43.63	38.79	38.12	24.19	10.25	0.74	0.00	
									(3)	(3)	(3)		
Gross Cash Yield (2)	-	-	225.40	225.40	225.40	225.40	225.40	225.40	225.40	135.24	45.08		
Crop Loss (4)	0.00	0.00	31.04	55.15	151.63	181.77	186.61	187.28	170.07	89.42	22.54		
Acreage Planted			0	60%	95%	100%							
Replanting:				(5)	(6)	(8)							
Added expense				14.27	74.57	137.88							
Expected reduced yield				0.00	11.27	101.43							
Adjusted Crop Loss (7)	0	0	0.00	14.27	214.92	218.22	186.61	187.28	170.07	89.42	22.54		
Damage Factor (9)	4%	3%	8%	10%	11%	12%	14%	9%	10%	9%	5%	5%	1.00
Damages per Acre	0	0	0.00	1.43	23.93	26.10	25.71	17.45	17.71	7.81	1.04	0.00	
AVERAGE ANNUAL DAMAGES PER ACRE													$121.19

(1) Firm Enterprise Data System, National Economic Div., ERS out of Oklahoma State University, Stillwater, OK: Total Costs for the State of Missouri: Costs of Production (1983 - updated to indicated price level and data from Doane's Agriculture Report Vol. 54, No. 11-5, dated 3/15/91, and Crop Prod. Costs, p. 103.)
(2) Average Yield in Bushels/Acre * Normalized Price.
(3) Five-year Average Harvest Times: 40% by Sept; 80% by Oct; 100% by Nov.
(4) Cash Yield less Unexpended Costs
(5) 60% acreage planted by Apr 30; 50% Apr average variable costs
(6) 1/2 May + Apr average variable cost; crop yield reduced by 5%.
(7) Crop Loss + Added Expense for Replanting
(8) 1/2 June + May + April average variable costs; crop reduced 45%. No replanting in July, so floods from July on result in Total Crop Loss.
(9) Damage Factor is the percent of expected total runoff occurring in a given month.

TABLE B-4

Bridges in the Study Area

Bridge	Elevation	Overtopped at Flood Frequency	Daily Traffic Count	Detour to Bridge
County No. 264	580	25%	75	257
County No. 358	575	10%	92	257
County No. 367	570	8%	100	Hwy D
County No. 238	606	3.5%	150	Hwy D
County No. 257	588	2%	88	Hwy D
State Road "D"	599	0.7%	126	Hwy 61
			631	

Detour mileage for the above impassable roads was determined, with the most direct detour routes used to compute the transportation damages. This report will set out the detailed analysis performed for County Bridge 264. A similar analysis was done for each of the above bridges to determine the total detour and opportunity costs. Table B-5 shows the traffic detour days on an annual basis by various traffic categories for County Bridge 264.

TABLE B-5

Annual Number of Trips

Vehicle Type	Annual Detour Days	Average Daily Number of Trips	Total Annual Number of Trips
Passenger Cars	365	70	25,550
School Buses	180	5	900
Mail Vehicles	302	1	302
Farm Machinery	129	2	258
Emergency Vehicles	365	1	365
		Total Number of Trips	27,375
Daily Traffic Count = 78 x 365 days per year =			27,375

The 1990 average operating cost per mile for passenger cars was $0.21, and for all trucks was $0.61. Operating costs for farm machinery were obtained from Doane's Agricultural Reporting Service. Total detour mileage costs for County Bridge 264 for the 2.3-mile one-way detour are shown in table B-6.

TABLE B-6

Vehicle Operating Costs for a 1-Year, 2.3-Mile Detour

Vehicle Type	Total Annual Number of Trips	Operating Cost Per Mile ($)	Total Additional Operating Cost Per Year ($)
Passenger Cars	25,550	0.29	16,977
School Buses	900	0.61	1,262
Mail Vehicles	302	0.29	201
Farm Machinery	258	1.02	605
Emergency Vehicles	365	0.61	512
		Total Detour Costs	19,557

The opportunity cost of time is the value of work or leisure activities foregone for travel purposes. It is assumed that all farm machinery, mail vehicles, and trucks had one occupant, school buses had a driver and 16 children, and emergency and passenger vehicles had a driver and one passenger. It was assumed that 23 percent of all traffic was leisure related, based upon total county population and total employed persons over the age of 18.

It was assumed that vehicles would be driven at an average of 45 mph and detour times were calculated for each detour route. Detour travel time would be 0.06 of an hour. Opportunity time cost was based on the national average hourly wages for the above occupations based upon U.S. Department of Commerce April 1991 wage rates, adjusted by a factor determined by United States per capita income and the respective county per capita income, as taken from the April 1991 issue of the U.S. Department of Commerce, *Survey of Current Business*.

Wages used for the various drivers were $9.53 per hour for trucks, $10.89 for mail vehicles, $7.78 for emergency vehicles, $5.66 for school buses, and $5.76 for farm machinery. Passenger car driver's wages of $7.07 are the average of the general hourly wage rate and the average hourly minimum wage. For passenger cars, the value of time was assumed to equal one-third of the average hourly wage. This was further adjusted to reflect that 25 percent of Clark County residents are under age 18, making the hourly opportunity cost of time for passenger cars $2.05. Table B-7 shows the opportunity time costs for a 1-year, 0.06-mile detour.

TABLE B-7

Opportunity Time Costs for a 1-Year, 0.06-Mile Detour

Vehicle Type	Total Annual Number of Trips	Opportunity Time Cost Per Hour	Opportunity Time Cost Per Year ($)
Passenger Cars	25,550	$ 2.05	3,012
School Buses	900	22.66	1,173
Mail Vehicles	302	10.89	189
Farm Machinery	258	5.76	85
Emergency Vehicles	365	9.53	200
		Total Opportunity Costs	4,659

Total detour and opportunity time costs are $24,216. Annualized at 8-3/4 percent, average annual detour opportunity costs for all drivers are $2,151 for closure of County Bridge 264 by a 4-year flooding event. Traffic from this bridge would use County Bridge 257, which would close because of being overtopped by a 50-year flooding event. This would result in an additional 0.04-mile detour for these vehicles, increasing their detour and opportunity costs to $40,009, or $3,554. Overtopping of that bridge would necessitate detour of this traffic to State Highway "D," incurring an additional 0.65-mile detour for total costs of $313,800, or $27,874 annualized.

A similar analysis was done for each of the bridges that would be closed because of flooding by the Wyaconda River. Total annualized damages were $176,000.

ROAD REPAIRS

In addition to the above would be the cost of repairing shoulders and embankments. At current price levels, it would cost $600/mile for paved surface roadways, $500/mile for gravel-topped or dirt roadways, and $1,000/mile for township roads. State of Missouri County Highways maps were used to determine the miles of roads which would be affected in the study area. Total cost of repair and grading would be $551,000, or $49,000 annualized at an 8-3/4 percent discount rate.

ALTERNATIVES

Eight alternatives were formulated for the study area. Six alternatives were eliminated from further consideration in an initial screening. Two alternative methods of protection were analyzed in detail. The first alternative was to provide protection to the study area by construction of a diversion channel. The second alternative was to separate the study area into 12 reaches, 6 on each side of the river, and to construct a levee for each reach. Both alternatives examined providing 10-, 100-, and 500-year levels of protection.

AVERAGE ANNUAL DAMAGES AND BENEFITS

Average annual benefits are the differences in damages "without project" and "with project." In addition to inundation reduction, benefits may be taken for a more intensive or improved use of the land and for employment of unemployed or underemployed individuals during construction of a project.

LOCATION BENEFITS

Location benefits are derived from the increased value of the land because of its location in the project area, separate and apart from any increase in value due to normal market increases. Local sources were consulted on the potential for an increase in agricultural land value if 100-year flood protection were provided. It was felt that there would be a nominal $200 to $300 increase in land value if flood protection were provided to a 100-year or better flooding event. With an average increase of $250 for the 9,200 acres of land, the annualized benefit would be $588,000.

INTENSIFICATION BENEFITS

Intensification benefits are allowable if the protection afforded by the project would allow a more intensive use of the agricultural land. For instance, if the project allowed a farmer to grow crops on land that had previously been used for growing hay, or merely used for pasture purposes, the increased production capabilities are calculated for the intensification benefit.

The project would affect 9,200 acres of land, the majority of which already is in crop production. It is assumed that some farmers would be able to more intensively use their acreage, but the overall crop production change would be minimal.

REDEVELOPMENT BENEFITS

None of the counties in the Wyaconda River main stem study area qualify as an area with substantial and persistent unemployment. No redevelopment benefits are allowable.

DIVERSION CHANNEL

Average annual damages and benefits for providing a 10-, 100-, and 500-year level of protection by constructing a diversion channel for the study area are shown in table B-8.

TABLE B-8

Average Annual Damages and Benefits-Diversion Channel
July 1991 Price Levels (in $1,000's)

	Average Annual Damages	Average Annual Benefits Level of Protection		
		10-Year	100-Year	500-Year
Agriculture	$160	$117	$153	$159
Roads	49	19	35	49
Detour	176	35	152	176
Location Benefit	0	40	176	204
Total	$385	$211	$516	$588

AVERAGE ANNUAL COSTS

Construction costs and operation and maintenance costs detailed in this report are at July 1991 price levels. Cost figures do not include lands, easements, and rights-of-way; interior drainage facilities; or environmental mitigation. Interest during the various construction periods and annualized costs were computed at 8-3/4 percent for a 50-year period of analysis. Table B-9 summarizes the interest calculations during the 3-year construction period.

TABLE B-9

Interest During Construction-Diversion Channel
July 1991 Price Levels (in $1,000's)

Year	Cost	Time to Base Year	Period	Interest Factor	Interest
10-Year Project					
1	$ 6,700.0	2.5	(5)	0.23331	$1,563.0
2	6,700.0	1.5	(3)	0.13408	898.0
2.5	6,700.0	0.5	(1)	0.04283	287.0
	$20,100.0				$2,748.0
100-Year Project					
1	$ 6,900.0	2.5	(5)	0.23331	$1,610.0
2	6,900.0	1.5	(3)	0.13408	925.0
2.5	6,900.0	0.5	(1)	0.04283	296.0
	$20,700.0				$2,831.0
500-Year Project					
1	$ 7,267.0	2.5	(5)	0.23331	$1,696.0
2	7,267.0	1.5	(3)	0.13408	974.0
2.5	7,266.0	0.5	(1)	0.04283	311.0
	$21,800.0				$2,981.0

Table B-10 shows the average annual costs for providing a 10-, 100-, and 500-year level of protection.

TABLE B-10

Average Annual Costs-Diversion Channel
July 1991 Price Levels (in $1,000's)

	10-Year	100-Year	500-Year
Project Costs	20,100	20,700	21,800
Interest During Construction	2,749	2,831	2,981
Total First Cost	22,849	23,531	24,781
Interest and Amortization	2,030	2,090	2,202
Operations and Maintenance	3	3	3
Total Average Annual Cost	2,033	2,093	2,205

ECONOMIC SUMMARY

Table B-11 presents the summary economic analysis for construction of the diversion channel alternative considered in this report.

TABLE B-11

Economic Analysis Summary-Diversion Channel
July 1991 Price Levels (in $1,000's)

	Level of Protection		
	10-Year	100-Year	500-Year
Total First Cost	$22,849	$23,531	$24,781
Average Annual Cost	2,033	2,093	2,205
Average Annual Benefit	171	340	384
Net Benefits	$(1,861)	$(1,753)	$(1,820)
Benefit-to-Cost Ratio	0.08	0.16	0.17

LEVEES

Average annual damages from existing conditions and benefits from providing levee protection to a 10-, 100-, and 500-year flooding event were determined for each of the 12 reaches. Table B-9 shows the total average annual damages and benefits for each of the 12 reaches. "L" refers to the left bank and "R" to the right bank of the river (see plate 1 of the main report). The respective columns are not totalled, as comparing the totals in tables B-8 and B-12 would be misleading. When looked at separately by reach, the transportation damages are assigned to each side of the river if the bridge is impassable, resulting in an increase in the overall total damages and benefits.

TABLE B-12

Average Annual Damages and Benefits-Levees
1991 Price Levels (in $1,000's)

	Average Annual Damages	Average Annual and Location Benefit Level of Protection								
		10-	Int.	Total	100-	Int.	Total	500-	Int.	Total
L-1	11	5	13	18	9	22	31	11	22	33
L-2	45	18	7	25	36	14	50	45	18	63
L-3	30	4	9	13	25	11	36	30	11	41
L-4	36	25	12	37	34	14	48	36	14	50
L-5	34	25	10	35	31	13	44	34	13	47
L-6	78	44	9	53	73	13	86	78	13	91
R-1	8	2	7	9	4	11	15	8	11	19
R-2	48	19	7	26	41	13	54	48	13	61
R-3	8	6	8	14	8	11	19	8	11	19
R-4	66	36	28	64	62	31	93	66	32	8
R-5	49	39	14	53	46	17	63	49	17	66
R-6	110	71	23	94	104	28	132	110	28	138

To determine whether constructing levees to protect any or all of the 12 separable reaches is economically feasible, interest during construction and average annual costs were computed for each of the 12 reaches for the same 3 levels of protection. Tables B-13 through B-15 show these summaries.

As indicated by these tables, none of the alternatives studied are economically feasible. As a Federal interest has not been determined, no Financial Impact to Local Sponsors or Ability to Pay Analysis are included.

SENSITIVITY ANALYSIS

Many small streams are located throughout the study basin. Road crossings over these streams vary from none to simply a gravel base. No analysis was done on repair of damage to these road crossings or estimation of detour costs.

For this economic analysis, ground elevations and bridge elevations were based upon USGS quadrangle maps which indicated the major bridge elevations. All other elevations were determined using these quadrangle maps which necessitated interpreting from 20-foot contours.

Table B-13
Interest During Construction
July 1991 Price Levels - In Thousands

Reach	Level of Protection	Project First Costs	Years	Period to Base Year	Factor	Interest	TOTAL PROJECT COSTS
L1 Levee	10-yr	1,480	1	0.5	0.04283	63.4	1543
	100-yr	2,480	1	0.5	0.04283	106.2	2586
	500-yr	4,240	1	0.5	0.04283	181.6	4422
L2 Levee	10-yr	1,200	1	0.5	0.04283	51.4	1251
	100-yr	2,300	1	0.5	0.04283	98.5	2399
	500-yr	3,380	1	0.5	0.04283	144.8	3525
L3 Levee	10-yr	2,160	1	0.5	0.04283	92.5	2253
	100-yr	3,210	1	0.5	0.04283	137.5	3347
	500-yr	3,800	1	0.5	0.04283	162.8	3963
L4 Levee	10-yr	1,860	1	0.5	0.04283	79.7	1940
	100-yr	2,400	1	0.5	0.04283	102.8	2503
	500-yr	3,080	1	0.5	0.04283	131.9	3212
L5 Levee	10-yr	1,350	1	0.5	0.04283	57.8	1408
	100-yr	2,020	1	0.5	0.04283	86.5	2107
	500-yr	2,700	1	0.5	0.04283	115.6	2816
L6 Levee	10-yr	2,540	1	0.5	0.04283	108.8	2649
	100-yr	4,100	1	0.5	0.04283	175.6	4276
	500-yr	5,880	1	0.5	0.04283	251.9	6132
R1 Levee	10-yr	1,630	1	0.5	0.04283	69.8	$1,700
	100-yr	2,600	1	0.5	0.04283	111.4	2,711
	500-yr	4,100	1	0.5	0.04283	175.6	4,276
R2 Levee	10-yr	1,380	1	0.5	0.04283	59.1	1,439
	100-yr	2,680	1	0.5	0.04283	114.8	2,795
	500-yr	3,840	1	0.5	0.04283	164.5	4,004
R3 Levee	10-yr	1,520	1	0.5	0.04283	65.1	1,585
	100-yr	2,540	1	0.5	0.04283	108.8	2,649
	500-yr	3,710	1	0.5	0.04283	158.9	3,869

Table B-13 - Continued

Reach	Level of Protection	Project First Costs	Years	Period to Base Year	Factor	Interest	TOTAL PROJECT COSTS
R4 Levee	10-yr	8,290	2	1.5	0.13408	555.8	
				0.5	0.04283	177.5	9,023
	100-yr	11,500	2	1.5	0.13408	771.0	
				0.5	0.04283	246.3	12,517
	500-yr	13,800	2	1.5	0.13408	925.2	
				0.5	0.04283	295.5	15,021
R5 Levee	10-yr	4,590	2	1.5	0.13408	307.7	
				0.5	0.04283	98.3	4,996
	100-yr	6,630	2	1.5	0.13408	444.5	
				0.5	0.04283	142.0	7,216
	500-yr	8,920	2	1.5	0.13408	598.0	
				0.5	0.04283	191.0	9,709
R6 Levee	10-yr	3,190	1	0.5	0.04283	136.6	3,327
	100-yr	5,580	1	0.5	0.04283	239.0	5,819
	500-yr	8,380	1	0.5	0.04283	358.9	8,739

Table B-14
Average Annual Costs
July 1991 Price Levels - In Thousands

Reach	Level of Protection	Project First Costs	Interest During Construc.	TOTAL FIRST COSTS	I and A At 8-3/4%	O & M	Total Average Annual Cost
L1 Levee	10-yr	1,480	63.4	1,543	137	0.5	138
	100-yr	2,480	106.2	2,586	230	0.5	230
	500-yr	4,240	181.6	4,422	393	0.5	393
L2 Levee	10-yr	1,200	51.4	1,251	111	0.5	112
	100-yr	2,300	98.5	2,399	213	0.5	214
	500-yr	3,380	144.8	3,525	313	0.5	314
L3 Levee	10-yr	2,160	92.5	2,253	200	0.5	201
	100-yr	3,210	137.5	3,347	297	0.5	298
	500-yr	3,800	162.8	3,963	352	0.5	353
L4 Levee	10-yr	1,860	79.7	1,940	172	0.5	173
	100-yr	2,400	102.8	2,503	222	0.5	223
	500-yr	3,080	131.9	3,212	285	0.5	286
L5 Levee	10-yr	1,350	57.8	1,408	125	0.5	126
	100-yr	2,020	86.5	2,107	187	0.5	188
	500-yr	2,700	115.6	2,816	250	0.5	251
L6 Levee	10-yr	2,540	108.8	2,649	235	0.6	236
	100-yr	4,100	175.6	4,276	380	0.6	380
	500-yr	5,880	251.9	6,132	545	0.6	545
R1 Levee	10-yr	1,630	69.8	$1,700	151	0.75	152
	100-yr	2,600	111.4	2,711	241	0.75	242
	500-yr	4,100	175.6	4,276	380	0.75	381
R2 Levee	10-yr	1,380	59.1	1,439	128	0.5	128
	100-yr	2,680	114.8	2,795	248	0.5	249
	500-yr	3,840	164.5	4,004	356	0.5	356
R3 Levee	10-yr	1,520	65.1	1,585	141	0.5	141
	100-yr	2,540	108.8	2,649	235	0.5	236
	500-yr	3,710	158.9	3,869	344	0.5	344

Table B-14 - Continued

Reach	Level of Protec-tion	Project First Costs	Interest During Construc.	TOTAL FIRST COSTS	I and A At 8-3/4%	O & M	Total Average Annual Cost
R4 Levee	10-yr	8,290	553.8				
			177.5	9,023	802	2.0	804
	100-yr	11,500	771.0				
			246.3	12,517	1112	2.0	1114
	500-yr	13,800	925.2				
			295.5	15,021	1334	2.0	1336
R5 Levee	10-yr	4,590	307.7				
			98.3	4,996	444	1.0	445
	100-yr	6,630	444.5				
			142.0	7,216	641	1.0	642
	500-yr	8,920	598.0				
			191.0	9,709	863	1.0	864
R6 Levee	10-yr	3,190	136.6	3,327	296	1.0	297
	100-yr	5,580	239.0	5,819	517	1.0	518
	500-yr	8,380	358.9	8,739	776	1.0	777

Table B-15
Economic Analysis Summary
July 1991 Price Levels - In Thousands

Reach	Level of Protection	Total First Costs	Average Annual Cost	Average Annual Benefit	Net Benefits	Benefit to Cost Ratio
L1 Levee	10-yr	1,543	138	18	(120)	0.13
	100-yr	2,586	230	28	(202)	0.12
	500-yr	4,422	393	31	(362)	0.08
L2 Levee	10-yr	1,251	112	18	(94)	0.16
	100-yr	2,399	214	36	(178)	0.17
	500-yr	3,525	314	46	(268)	0.15
L3 Levee	10-yr	2,253	201	4	(197)	0.02
	100-yr	3,347	298	25	(273)	0.08
	500-yr	3,963	353	30	(323)	0.09
L4 Levee	10-yr	1,940	173	40	(133)	0.23
	100-yr	2,503	223	51	(172)	0.23
	500-yr	3,212	286	54	(232)	0.19
L5 Levee	10-yr	1,408	126	25	(101)	0.20
	100-yr	2,107	188	31	(157)	0.17
	500-yr	2,816	251	34	(217)	0.14
L6 Levee	10-yr	2,649	236	51	(185)	0.22
	100-yr	4,276	380	82	(298)	0.22
	500-yr	6,132	545	87	(458)	0.16
R1 Levee	10-yr	1,700	152	2	(150)	0.01
	100-yr	2,711	241	4	(237)	0.02
	500-yr	4,276	380	8	(372)	0.02
R2 Levee	10-yr	1,439	128	19	(109)	0.15
	100-yr	2,795	249	41	(208)	0.16
	500-yr	4,004	356	48	(308)	0.13
R3 Levee	10-yr	1,585	141	8	(133)	0.06
	100-yr	2,649	236	11	(225)	0.05
	500-yr	3,869	344	11	(333)	0.03

Table B-15 - Continued

Reach	Level of Protection	Total First Costs	Average Annual Cost	Average Annual Benefit	Net Benefits	Benefit to Cost Ratio
R4 Levee	10-yr	9,023	804	69	(735)	0.09
	100-yr	12,517	1114	100	(1,014)	0.09
	500-yr	15,021	1336	104	(1,232)	0.08
R5 Levee	10-yr	4,996	446	58	(388)	0.13
	100-yr	7,216	643	69	(574)	0.11
	500-yr	9,709	865	73	(792)	0.08
R6 Levee	10-yr	3,327	297	133	(164)	0.45
	100-yr	5,819	518	178	(340)	0.34
	500-yr	8,739	777	185	(592)	0.24

APPENDIX C

PERTINENT CORRESPONDENCE

RECONNAISSANCE REPORT
FLOOD CONTROL AND OTHER WATER-RELATED PURPOSES
WYACONDA RIVER BASIN, MISSOURI AND IOWA

APPENDIX C
PERTINENT CORRESPONDENCE

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Clark County

Leih Ann Hayden
County Clerk

111 East Court • Kahoka, Missouri 63445
816-727-3283

December 7, 1987

Pat Burke
Planning Section
Army Corps of Engineers
Clock Tower Building
Rock Island, Illinois 61201

Dear Mr. Burke:

The Clark County Commission wish to express our concern regarding the flooding on the Wyaconda River.

As a County Commission we are responsible for roads & bridges in the area. In the flood of Sept. - Oct. 1986 we experienced nearly $150,000.00 in damages to bridges & Roads in that area of our County. Much of this could have been avoided if there had been adequate measures taken to control erosion and water before it reached the main channel. We feel it would be more cost effective to control the water flow before it reaches the main channel than try to control the flow after it gets there.

We wholeheartedly support the study of the Wyaconda River Basin and are willing to do anything we can to help in this study. If we can be of any help to you or your staff please feel free to contact us in this matter.

We are putting together a list of losses that were incurred by farmers in this area and will furnish this as soon as possible. We would ask that this study be concluded as soon as possible. Thank-you for your work in this study of the Wyaconda River Basin.

Sincerely,

Wayne J. Blum
Presiding Commissioner

Charles J. Allen
Eastern District Commissioner

Eddie Brewer
Western District Commissioner

Leih Ann Hayden
County Clerk

Clark County

111 East Court • Kahoka, Missouri 63445
816-727-3283

July 15, 1988

U.S. Army Corps of Engineers
Clock Tower Building, P.O. Box 2004
Rock Island, Illinois 61204-2004

RE: Wyaconda River Basin

Dear Sirs:

This letter is to inform you that the Clark County Commission is willing to support the study of the Wyaconda River Basin and to help in any way that is feasible for the county to do. We will ask the adjoining counties to join in this study also.

Even though the County is not financially able to contribute at this time we are willing to lead the drive to raise money from those involved for these matching funds.

Please keep us informed of the progress of this study so we can start our drive to raise these funds.

Sincerely,

Leih Ann Hayden

Clark County Commission
Leih Ann Hayden, County Clerk

cc: Lucille Danker
Herb Schutte

Clark County

111 East Court • Kahoka, Missouri 63445
Phone: 816-727-3283

Leih Ann Hayden
County Clerk

Nadine Shannon
Deputy Clerk

June 22, 1989

U. S. Army Corps of Engineers
Clock Tower Building
P.O. Box 2004
Rock Island, Illinois 61204-2004

RE: Wyaconda River Basin

Dear Sirs:

On July 15, 1988, we sent you a letter about the possibility of funds being made available for a study of the Wyaconda River Basin. We are aware that our request for aid was not approved for the FY1990 Budget. We would like for you to give our request for funds from the FY 1991 Budget, your immediate attention.

This study of the Wyaconda River Basin is very important to the agricultural economy of this area. With our history of past flooding, many acres of valuable cropland have been devastated.

If we may be of any further assistance in obtaining this study of the Wyaconda River Basin, please contact us at the address above.

Thanking you in advance, we remain

Cordially yours,

Wayne J. Blum

Wayne J. Blum
Clark County Presiding Commissioner

cc: Lucile Danker

Clark County

111 East Court • Kahoka, Missouri 63445
Phone: 816-727-3283

Leih Ann Hayden
County Clerk

June 4, 1990

U. S. Army Corps of Engineers
Clock Tower Building
P.O. Box 2004
Rock Island, Illinois 61204-2004

RE: Wyaconda River Basin

ATTN: Planning Division

Dear Sir:

This letter is to inform you that the Clark County Commission is still very interested in getting a flood control study on the Wyaconda River Basin. This study would help the area farmers in this drainage area.

We have tried for several years to get this project started, but so far we have not been successful. We, the Clark Commission, would like to remind you that we give our support to this project and we will help in any way that is feasibly possible.

We would like to be kept informed of any new developments concerning the Wyaconda River Basin study.

Please feel free to contact us if you have any questions.

Sincerely,

Wayne J. Blum

Wayne J. Blum
Clark County Presiding Commissioner

WJB/lah

DEPARTMENT OF THE ARMY
ROCK ISLAND DISTRICT, CORPS OF ENGINEERS
CLOCK TOWER BUILDING—P.O. BOX 2004
ROCK ISLAND, ILLINOIS 61204-2004

REPLY TO ATTENTION OF

February 5, 1991

Planning Division

NOTICE OF INITIATION

Reconnaissance Study
for
Flood Control and Other Water-Related Purposes

Wyaconda River Basin
Missouri and Iowa

The Rock Island District of the U.S. Army Corps of Engineers has initiated a reconnaissance study for flood control and other water-related purposes in the Wyaconda River Basin, Missouri and Iowa, with particular reference to Clark and Lewis Counties, Missouri. This study was authorized on September 23, 1987, by resolution of the Committee on Public Works and Transportation, U.S. House of Representatives.

The Wyaconda River Basin encompasses an area of 458 square miles and is about 70 miles long and 8 miles at its greatest width. The river's headwaters are located in Davis County, Iowa, and flow southeast to enter the Mississippi River at La Grange, Missouri. The study area is shown on the enclosed map.

The purpose of this reconnaissance study is to define problems and opportunities in the Wyaconda River Basin and identify potential solutions; determine whether there is a Federal interest in further studies (feasibility phase), based on cost, benefits, and environmental impacts of the identified potential solutions; and assess the non-Federal level of interest and support in the identified potential solutions.

The problems to be addressed in the study include flood induced physical damage to crops, property, and roadways.

Throughout the study process, the Corps of Engineers will coordinate with the States of Missouri and Iowa, including all correspondence, in accordance with Executive Order 12372.

Your knowledge of problems and opportunities in the study area are important to the reconnaissance study. Our Study Manager is Mr. George F. Gitter, Flood Control and Special Studies Branch, Planning Division. He may be reached at telephone 309/788-6361, Ext. 6387. Any information you may have regarding this study, as well as comments or concerns, may be sent to the following address:

District Engineer
U.S. Army Engineer District, Rock Island
ATTN: Planning Division (George Gitter)
Clock Tower Building - P.O. Box 2004
Rock Island, Illinois 61204-2004

As part of the public involvement process, you will be kept informed of significant study findings.

Sincerely,

John R. Brown
Colonel, U.S. Army
District Engineer

Enclosure

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION VII
726 MINNESOTA AVENUE
KANSAS CITY, KANSAS 66101

February 12, 1991

Colonel John R. Brown, USA
U.S. Army Engineer District, Rock Island
ATTN: Planning Division
Clock Tower Building - P.O. Box 2004
Rock Island, Illinois 61204-2004

Dear Colonel Brown:

This is in response to your Notice of Initiation of the Reconnaissance Study for flood control and other water-related purposes for the Wyaconda River Basin, Missouri and Iowa.

A review of our CERCLIS (abandoned, inactive or uncontrolled hazardous waste sites) data current as of January 4, 1991, listed the following sites in the project area and their status:

Site	Status
MOD000687475 Gardner-Denver Company North Main Street La Grange, Missouri 63448	Preliminary assessment (PA) complete; no further action needed under CERCLA; regulated by RCRA
IAT200010346 Amoco Fertilizer Plant W Karr Avenue Bloomfield, Iowa 52537	PA complete; no further action needed under CERCLA
IA0980688345 Bloomfield Foundry Inc. Karr Avenue Bloomfield, Iowa 52537	PA complete; no further action needed under CERCLA; regulated by RCRA
IAD022027668 Hoskins Elevator Warehouse Rt. 6 Bloomfield, Iowa 52537	PA complete; need for further action undetermined
IAD980630495 Van Buren County Landfill RFD Douds, Iowa 52551	PA complete; no further action needed under CERCLA

IAD984566216
Gire Farm Service
Highway 98
Douds, Iowa 52551

PA complete; no further action needed under CERCLA

We note also that National Wetland Inventory maps are available for the five county study area and should be consulted for the presence of wetlands.

Thank you for the opportunity to comment. Any questions on these comments can be directed to Mr. Mike Bronoski of my staff at 913/551-7291.

Sincerely,

Lawrence M. Cavin
Chief, Environmental Review
and Coordination Section

United States Department of Agriculture
Soil Conservation Service
210 Walnut Street
693 Federal Building
Des Moines, Iowa 50309

March 8, 1991

Colonel John R. Brown
U.S. Army District Engineer
Department of the Army
Rock Island District
Corps of Engineers
Clock Tower Building
P.O. Box 2004
Rock Island, Illinois 61204-2004

Dear Colonel Brown:

The Notice of Initiation for a reconnaissance study for flood control and other related purposes regarding the Wyaconda River Basin, Missouri and Iowa has been reviewed by my staff.

It is important you are aware of the following: The South Wyaconda River was studied by the Soil Conservation Service and a plan totally implemented in the 36,255 acre watershed. An application for PL-566 assistance was approved in April 1957 with construction completed in 1979.

You should also be aware that a request to study the North Wyaconda is on file. This request includes Davis and Van Buren Counties in Iowa and Scotland and Clark Counties in Missouri. The total size of this watershed is 73,500 acres, 21,315 acres in Iowa and 52,185 acres in Missouri. This request for assistance was approved in July 1963. The North Wyaconda plan will be prepared by the Soil Conservation Service staff in Missouri.

Public Law 566 authorizes the Soil Conservation Service to prepare plans and provide assistance in watersheds of less than 250,000 acres. The remaining area which requires treatment is well within the criteria for PL-566 assistance. The application we received includes the watershed area to the junction of the South and North Wyaconda. Basically, the Little Wyaconda River, Sugar Creek, and Crooked Creek would be the remaining areas to be studied. These are well within the size criteria of PL-566 and would be quite small for traditional USACOE assistance. We recommend these projects be given further attention through PL-566 if local people feel additional assistance is needed in these areas.

If further information or discussion is required, please feel free to contact James M. Reel, WRPS Leader, at (515) 284-4135.

Sincerely,

Jeffrey R. Vonk
State Conservationist

United States Department of Agriculture

Soil Conservation Service

555 Vandiver Drive
Columbia, Missouri
65202

March 15, 1991

Colonel John R. Brown
District Engineer
Rock Island District
Corps of Engineers
P. O. Box 2004
Rock Island, Illinois 61204-2004

Dear Colonel Brown:

This is in response to the Notice of Initiation for a reconnaissance study for flood control and related purposes in the Wyaconda River Basin, Missouri and Iowa.

Through the authorities of the Watershed Protection and Flood Prevention Act (Public Law 83-566), the Soil Conservation Service has provided planning and implementation assistance to this basin since the mid-1950's. P.L.-566 authorizes the Soil Conservation Service to provide financial and technical assistance to local sponsors in watersheds of 250,000 acres and less.

At the present time, applications for P.L.-566 assistance have been made by local sponsors on four watersheds within the study area. The South Wyaconda River Watershed (36,255 acres in Iowa) has a completed watershed plan with all measures installed. The Little Wyaconda River-Sugar Creek Watershed (98,958 acres) has a completed plan with partial installation of planned measures.

The North Wyaconda River Watershed (73,500 acres, 21,315 acres in Iowa and 52,185 acres in Missouri) has an active application on file with our office. Some preliminary field information has been collected and at some date when staffing and funding are available we plan to complete the study on North Wyaconda River Watershed.

Please contact Mike Wells, Assistant State Conservationist for Water Resources at 314/875-5213, if the Soil Conservation Service can be of assistance.

Sincerely,

Michael D Wells
ACTING

RUSSELL C. MILLS
State Conservationist

cc: Jeffrey R. Vonk, State Conservationist, SCS, Des Moines, IA
Lynn Kilpatrick, Area Conservationist, SCS, Hannibal, MO

MISSOURI DEPARTMENT OF CONSERVATION

MAILING ADDRESS
P.O. Box 180
Jefferson City, Missouri 65102-0180

STREET LOCATION
2901 West Truman Boulevard
Jefferson City, Missouri

Telephone: 314/751-4115
JERRY J. PRESLEY, Director

March 21, 1991

Colonel John R. Brown
Rock Island District, Corps of Engineers
Clock Tower Building
P. O. Box 2004
Rock Island, Illinois 61204-2004

Attn: Planning Division (George Gitter)

Dear Colonel Brown:

We appreciate the opportunity to provide input into the reconnaissance study for flood control and other water-related purposes in the Wyaconda River basin. It is our view that much can be accomplished in the Wyaconda River basin to restore water quality and provide flood damage reduction. With that in mind, we offer the following general areas of interest to this Department.

1. Environmental - Delineate, restore and protect floodways on Wyaconda River and tributaries in the study area. Measures that would work include reforestation of riparian corridor/floodway, reforest uplands to double the ±20% forested area, reduce grazing in woodlands and attempt to restore wetlands. Based on historic records, these measures would also reduce flood damage.

2. Erosion - Delineate bank erosion areas and treat the sites with riprap, cedar tree revetment or vegetation such as willow cuttings. Erosion control would reduce sediment input and improve water quality.

3. Flooding - Flood damage reduction by restoration of trees in the floodway. Restoration of wetlands could benefit a wide array of species while providing other benefits.

4. Water Quality - Treat eroding banklines and, where channelization has occurred, restore stream gradient.

We look forward to providing input and insight to this effort. If you or your staff have questions, please contact William H. Dieffenbach of my staff.

Sincerely,

Dan F. Dickneite

DAN F. DICKNEITE
ENVIRONMENTAL ADMINISTRATOR

cc: U. S. Fish and Wildlife Service
Columbia, MO

Army Corps Engineers
Rock Island District

WYACONDA RIVER BASIN, MISSOURI AND IOWA, FLOOD CONTROL RECONNAISSANCE STUDY

OPEN HOUSE

* * * BACKGROUND * * *

The U.S. Army Corps of Engineers, Rock Island District, is studying the feasibility of measures for flood control and other water related purposes in the Wyaconda River Basin, Missouri and Iowa. The purpose of the study is to define problems and opportunities in the Wyaconda River Basin and to identify potential solutions; determine whether there is a Federal interest in further studies (feasibility phase) based on cost, benefits, and environmental impacts of the identified potential solutions; and assess the non-Federal level of interest and support in the identified potential solutions.

* * * PURPOSE OF OPEN HOUSE * * *

The purpose of the open house will be for the Corps of Engineers to gather input from the residents who live in and are familiar with the Wyaconda River Basin. Those attending will have the opportunity to discuss on a one-to-one basis with a Corps of Engineers representative information they may have on water resource problems and needs in the Wyaconda River Basin area.

* * * WHEN/WHERE * * *

Monday, May 20, 1991
1-4 p.m. and 6-8 p.m.

Court House
Circuit Court Room
111 East Court
Kahoka, Missouri

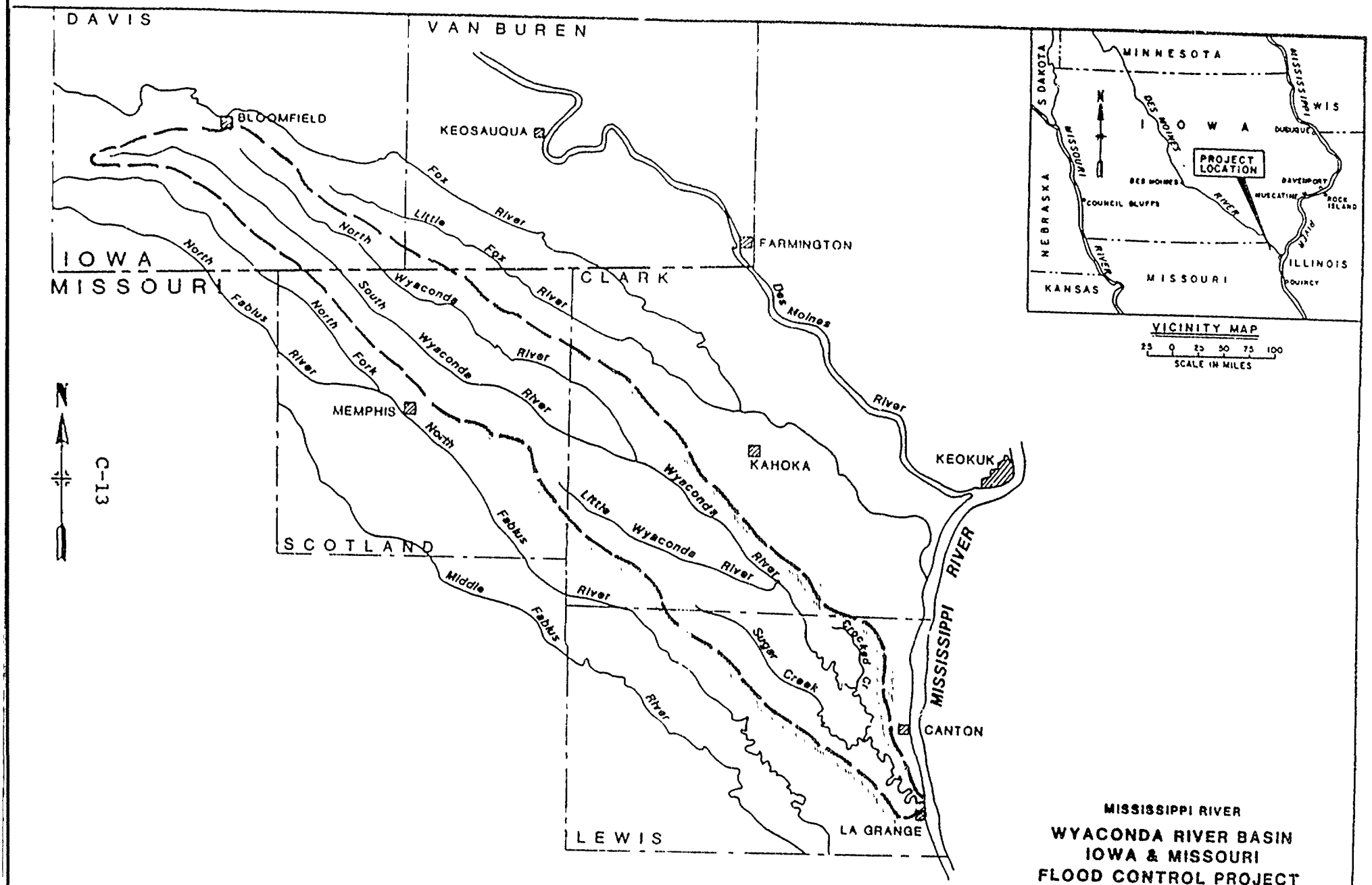
* * * WHO IS INVITED * * *

All interested persons are urged to attend the open house. This includes representatives of civic, business, recreation, and conservation groups; property owners; Federal and non-Federal agencies; and the public.

* * * FOR MORE INFORMATION * * *

Contact: District Engineer
U.S. Army Engineer District, Rock Island
ATTN: Planning Division
Clock Tower Building
Rock Island, Illinois 61204-2004

Or Call: Mr. George I. Gitter, Community Planner
309/788-6361, Ext. 6387



MISSISSIPPI RIVER

WYACONDA RIVER BASIN IOWA & MISSOURI FLOOD CONTROL PROJECT

ROCK ISLAND DISTRICT
CORPS OF ENGINEERS

OCTOBER 1988

HAROLD L VOLKMER
9TH CONGRESSIONAL DISTRICT
MISSOURI

2411 RAYBURN HOUSE OFFICE BUILDING
WASHINGTON DC 20515
(202) 225-2956

HOUSE COMMITTEE ON
AGRICULTURE

HOUSE COMMITTEE ON
SCIENCE AND TECHNOLOGY

SELECT COMMITTEE ON AGING

Congress of the United States

House of Representatives

Washington, DC 20515

May 14, 1991

DISTRICT OFFICES

ROOM 370
FEDERAL BUILDING
HANNIBAL MO 63401
(314) 221-1200

912 E WALNUT
COLUMBIA MO 65201
(314) 449-5111

122 BOURKE
MACON MO 63552
(816) 385-5615

317 LAFAYETTE
P O BOX 229
WASHINGTON MO 63090
(314) 239-4001

George Gitter
Community Planner
U.S. Army Engineer District
Attn: Planning Division
Clock Tower Division
Rock Island, Illinois 61204-2004

Dear George

Thank you for inviting me to the open house of the Wyaconda River Basin Flood Control Reconnaissance Study. I regret that I will be unable to attend as the House will be in session on May 20th.

I am sure this will be a productive meeting and I appreciate the thoughtful invitation. With kindest regards, I am

Sincerely,

Harold L. Volkmer
Member of Congress

HLV/pl

MISSOURI DEPARTMENT OF CONSERVATION

MAILING ADDRESS
P.O. Box 180
Jefferson City, Missouri 65102-0180

STREET LOCATION
2901 West Truman Boulevard
Jefferson City, Missouri

Telephone: 314/751-4115
JERRY J. PRESLEY, Director

May 24, 1991

Colonel John R. Brown
District Engineer
Rock Island District, Corps of Engineers
Clock Tower Building
P.O. Box 2004
Rock Island, IL 61201

RE: Wyaconda River Reconnaissance Study

Dear Colonel Brown:

We received a copy of your public notice regarding the feasibility study of the Wyaconda River Basin. Members of the Department staff have participated in other study efforts in the basin, including U.S. Department of Agriculture, Soil Conservation Service. As the agency responsible for fish, wildlife and forest resources in Missouri, we would appreciate the opportunity to be involved in this study.

When members of your staff need information or have questions relating to our resource responsibilities, please contact William H. Dieffenbach of my staff.

Sincerely,

W. H. Dieffenbach

DAN F. DICKNEITE
for PLANNING DIVISION CHIEF

cc: U.S. Fish and Wildlife Service (Columbia, Missouri)

DEPARTMENT OF THE ARMY
ROCK ISLAND DISTRICT. CORPS OF ENGINEERS
CLOCK TOWER BUILDING—P.O. BOX 2004
ROCK ISLAND. ILLINOIS 61204-2004

July 17, 1991

REPLY TO ATTENTION OF

Planning Division

NOTICE OF STUDY PROGRESS

Reconnaissance Study
for
Flood Control and Other Water-Related Purposes

Wyaconda River Basin
Missouri and Iowa

In December 1990, the Rock Island District of the U.S. Army Corps of Engineers (Corps) initiated a Reconnaissance Study for flood control and other water-related purposes in the Wyaconda River Basin. The authorization gave particular emphasis to Clark and Lewis Counties, Missouri (see attached map). The purpose of this letter is to provide an update of the study's progress.

The early months of the study were spent developing a computer model to calculate flood heights and assessing the nature and extent of flood problems. A field survey was conducted to estimate the amount and type of losses due to flooding, and potential project alternatives were formulated to reduce flood damages. The study is being coordinated with the U.S. Department of Agriculture - Soil Conservation Service (SCS). The SCS has been active in several sub-basin projects in the area.

On May 20, 1991, the Corps conducted an Open House at the County Courthouse in Kahoka, Missouri. The purpose of the Open House was for the Corps to gather information from persons who live in or are familiar with the Wyaconda River Basin.

The Open House was well attended. Approximately 55 Wyaconda Basin farmers, residents, and county representatives discussed their flooding problems with Corps representatives. The attendees were asked either to fill out a comment sheet at the Open House or to take the sheet with them for completion, and then mail it to the Corps' Rock Island District office. Some attendees took extra comment sheets to distribute to those who could not attend.

To date, we have received 32 comment sheets. About 90 percent of those who returned a comment sheet listed flood damage as a major problem. Almost 80 percent are concerned about losses of and damage to crop and pasture land. About 60 percent listed erosion as a problem; 35 percent are concerned about damage to roads and bridges, while almost 25 percent of those who responded listed damage to fences as a problem. Among the other concerns mentioned are the sharp bends of the Wyaconda River, water quality, and the effects of flooding on livestock and wildlife.

We are now assessing the economic viability of levee, channel, and diversion alternatives. Project alternatives move forward based upon a favorable benefit-to-cost ratio. Only project alternatives with economic benefits greater than costs may be considered in the next study phase, which is the feasibility study phase.

We also are working to identify a local sponsor(s) to cost share the feasibility study. A feasibility study is cost shared at 50 percent Federal and 50 percent non-Federal expense. Eligible potential local sponsors include state, county, and local units of government.

If you have any questions or comments about the Wyaconda River Basin Reconnaissance Study, please call Mr. George Gitter of our Flood Control and Special Studies Branch at 309/788-6361, Ext. 6387, or write to the following address:

District Engineer
U.S. Army Engineer District, Rock Island
ATTN: Planning Division
Clock Tower Building - P.O. Box 2004
Rock Island, Illinois 61204-2004

Sincerely,

Dudley M. Hanson, P.E.
Chief, Planning Division

Attachment

JOHN ASHCROFT
Governor

G. TRACY MEHAN III
Director

STATE OF MISSOURI
DEPARTMENT OF NATURAL RESOURCES
DIVISION OF PARKS, RECREATION, AND HISTORIC PRESERVATION
P.O. Box 176
Jefferson City, MO 65102
314-751-2479

Division of Energy
Division of Environmental Quality
Division of Geology and Land Survey
Division of Management Services
Divisionof Parks, Recreation,
and Historic Preservation

July 26, 1991

Mr. Dudley M. Hanson, P.E.
Chief, Planning Division
Department of the Army
Corps of Engineers
Clock Tower Bldg. P.O. Box 2004
Rock Island, IL 61204-2004

Dear Mr. Hanson:

This is in response to a "Notice of Study Progress" which was received recently in regard to the Wyaconda River Basin in northeast Missouri.

Enclosed please find a document titled "Canoeing in Northern Missouri" which was developed by the Department of Natural Resources. The Wyaconda River is described as "certainly one of the most beautiful stream corridors in all northern Missouri." Therefore, I would recommend that the study take into consideration the current use of the river for recreation purposes as well.

If we can assist you in any way, please feel free to contact us.

Sincerely,

DIVISION OF PARKS, RECREATION,
AND HISTORIC PRESERVATION

Wayne E. Gross
Director

WEG:mdl

Enclosure

MISSOURI DEPARTMENT OF CONSERVATION

MAILING ADDRESS
P.O. Box 180
Jefferson City, Missouri 65102-0180

STREET LOCATION
2901 West Truman Boulevard
Jefferson City, Missouri

Telephone: 314/751-4115
JERRY J. PRESLEY, Director

September 18, 1991

Mr. Dudley M. Hanson
Chief, Planning Division
Rock Island District, Corps of Engineers
P. O. Box 2004
Rock Island, IL 61204-2004

Re: Wyaconda River Reconnaissance Report

Dear Mr. Hanson:

Members of the Department staff reviewed the "Notice of Study Progress" and other reports dealing with the reconnaissance study you are conducting on part of Wyaconda River. The Department maintains the State Heritage Data Base. Inquiry of that data base yielded the following occurrences of sensitive elements.

Winged mapleleaf mussel (Quadrula fragosa) was recently listed as a federal endangered species. The species is listed as from St. Croix River, Minnesota-Wisconsin. Specimens as recent as 1968 are labeled as being taken from Wayland, Missouri. A search is currently being conducted to ascertain the status of this species in northeast Missouri.

Other species that occur in the vicinity associated with wetlands and river corridors are:

Blanding's turtle (Emydoidea blandingii)	State Endangered
Western fox snake (Elaphe vulpina vulpina)	State Endangered
Eastern massasauga (Sistrurus catenatus catenatus)	State Endangered
Central mudminnow (Umbra limi)	State Endangered
Dotted Monarda (monarda punctata)	State Endangered

It is our position to vigorously seek alternatives to channelization. Examples of what channelization has done and continues to inflict on fish and wildlife resources is all too apparent in northeast Missouri.

I hope this letter is of some assistance in your reconnaissance study effort. If you need additional input, please call.

Sincerely,

W. H. Dieffenbach

WILLIAM H. DIEFFENBACH
ASST. PLANNING DIVISION CHIEF

WHD:jct
cc: U. S. Fish and Wildlife Service

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Fish and Wildlife Enhancement
Columbia Field Office
608 East Cherry Street
Columbia, Missouri 65201

IN REPLY REFER TO

TAKE PRIDE IN AMERICA

FWS\FWE-CMFO

OCT 1 0 1991

Colonel John R. Brown
District Engineer
Rock Island District, Corps of Engineers
Clock Tower Building
Rock Island, Illinois 61201

Dear Colonel Brown:

This planning assistance letter is submitted by the U.S. Fish and Wildlife Service (Service) to the Rock Island District, U.S. Army Corps of Engineers (Corps) for use in the **Wyaconda River Basin Reconnaissance Study**, in accordance with the provisions of, and under the authority of the Fish and Wildlife Coordination Act (Coordination Act) (48 stat. 401, as amended; 16 U.S.C. 661 et seq.), and the "Agreement Between the U.S. Fish and Wildlife Service and the U.S. Army Corps of Engineers for funding Fish and Wildlife Coordination Activities." Our letter is submitted in accordance with provisions of the Coordination Act, but does not fulfill the reporting requirements of the Service under Section 2(b) of that Act.

The general project area includes Davis and Van Buren Counties, in Iowa, and, Scotland, Clark, and Lewis Counties, in Missouri. However, since the Corps has determined that the reconnaissance study would limit the area of consideration to the reach of the Wyaconda River from the mouth at the Mississippi River to five miles up the North and South branches, this letter identifies fish and wildlife resource problems and needs, and opportunities for only this area. Consequently, the emphasis of this letter will be placed upon Clark and Lewis Counties, Missouri. This letter fulfills the Fiscal Year 1991 Scope-of-Work items for problems, needs, and opportunities input from the Service, as defined in the May 22, 1991, Order for Reimbursable Services (NCR-IA-91-0059).

Description of the Study Area

The Wyaconda River Basin encompasses an area of approximately 458 square miles and is about 70 miles long and eight miles wide. The River's headwaters are located in Davis County, Iowa, and it flows in a southeasterly direction to empty into the Mississippi River at the town of LaGrange, in Lewis County, Missouri.

The study area is located within the Eastern Glaciated Plains Natural Division (Thom and Wilson, 1980). The soils and topography resulted from the Kansas stage of Pleistocene glaciation. Soils are formed from loess, glacial till, or alluvium along the river bottoms. The pre-settlement, natural vegetation of the area was almost equally divided between forest and prairie, with the prairie areas located primarily in the more level upland, and the forests occupying the slopes and bottomland areas. The floodplains were dominated by forest.

Clark County encompass approximately 327,000 acres, while Lewis County occupies about 324,000 acres. Row crop production takes place on approximately 165,000 acres in Clark County, and 191,000 acres in Lewis County. Forested acres amount to about 62,000 acres in Clark County, and about 41,000 acres in Lewis County. There are about 59,000 grassland acres in Clark County, and 65,000 acres in Lewis County. These figures demonstrate the highly agricultural nature of the study area and the significant changes in land use that have occurred since presettlement times.

The major hydrologic features within Clark County are the Little Fox, Fox, Wyaconda, and Little Wyaconda Rivers. The major drainages in Lewis County are the Wyaconda River, and it's tributary Sugar Creek, and the North and Middle Fabius Rivers. The headwaters of the majority of these rivers have been channelized, especially in the Wyaconda and Fabius River systems.

Fish and Wildlife Resources

Aquatic

Due to adjacent land uses, and alteration of the stream channel itself, the stream habitats in the study area have been severely degraded. Increased erosion and sedimentation, channelization, elimination of in-stream cover and deep water pools, and increased organic inputs from run-off from cropland and pasture land, have all contributed to a reduction in aquatic species diversity and abundance in the Wyaconda River. The lower approximately 31 miles of the Wyaconda River in Lewis County to the mouth still maintains a meandering channel. Above that point (approximately T.63N., R.7W., section 35), the River has been extensively channelized, with few meanders remaining. Suckers (Catostomids) and small-mouth bass (Micropterus dolomieui) that require cooler, clearer water are no longer present to any degree.

There are at least 52 different fish species found in the Wyaconda River in Clark and Lewis Counties. Common fish species currently found within the entire study area include: orangespotted (Lepomis humilis) and green (L. cyanellus) sunfish, and bluegill (L. macrochirus); channel catfish (Ictalurus punctatus) and yellow bullhead (I. natalis); common carp (Cyprinus carpio); river carpsucker (Carpiodes carpio); central stoneroller (Campostoma anomalum); red (Notropis lutrensis), emerald (N. atherinoides), and bigmouth (N dorsalis)

shiners; fathead (Pimephales promelas) and bluntnose (P. notatus) minnows; white (Pomoxis annularis) and black (P. nigromaculatus) crappie; white bass (Morone chrysops); and, largemouth bass (Micropterus salmoides). The lower Wyaconda River in Lewis County supports fish species commonly found in the Mississippi River, such as the freshwater drum (Aplodinotus grunniens), smallmouth (Ictiobus bubalus) and bigmouth (I. cyprinellus) buffalo, redhorse (Moxostoma spp.), and flathead catfish (Pylodictis olivaris).

Terrestrial

The majority of uplands in the study area were at one time covered by pre-settlement prairie, and were dominated by such species as big bluestem (Andropogon gerardii), Indiangrass (Sorghastrum nutans), little bluestem (Shizachiarium scoparium), pale-purple coneflower (Echinacea pallida), and lead plant (Amorpha canescens). Almost all of the native prairie has been converted to fescue pasture or row crops.

Scattered upland forested areas were dominated by white oak (Quercus alba), red oak (Q. rubra), shagbark hickory (Carya ovata), basswood (Tilia americana), and American elm (Ulmus americana). Xeric glades were present as well, with red cedar (Juniperus virginiana) interspersed amongst the prairie plants. Many of the upland forests were harvested, either partially or clear-cut. A large percentage of existing forest land is in poor condition due to previous logging or current cattle grazing.

There is a limited amount of remaining bottomland forest, most of which is scattered in many small parcels along the Wyaconda River and its former channel and tributaries. Typical tree species present include cottonwood (Populus deltoides), black willow (Salix niger), silver maple (Acer saccharinum), sugar maple (A. saccharum), box elder (A. negundo), green ash (Fraxinus pennsylvanica), sycamore (Plantanus occidentalis), and black walnut (Juglans nigra).

The Missouri Natural Areas Inventory (Anderson 1983) recognized the lower two miles of the Wyaconda River as a "significant area" since the plant communities along the cliff face and the ravines are mostly undisturbed, scattered upland forest and small open glades.

Typical mammalian species that inhabit the study area include the white-tailed deer (Odocoileus virginianus), coyote (Canis latrans), gray fox (Urocyon cinereoargenteus), red fox (Vulpes vulpes), raccoon (Procyon lotor), striped skunk (Mephitis mephitis), opossum (Didelphis virginiana), and gray squirrel (Sciurus carolinensis).

Common avian species in the study area include the American kestrel (Falco sparverius), red headed woodpecker (Melanerpes erythrocephalus), eastern meadowlark (Sturnella magna), eastern kingbird (Tyrannus tyrannus), eastern bluebird (Sialia sialis), field sparrow (Spizella

pusilla), dickcissel (Spiza americana), horned lark (Eremophila alpestris), common flicker (Colaptes auratus), northern oriole (Icterus galbula), mockingbird (Mimus polyglottos), gray catbird (Dumetella carolinensis), brown thrasher (Toxostoma rufum), green heron (Butorides striatus), and great blue heron (Ardea herodias).

Wetland Resources

A review of the data in the Service's National Wetlands Inventory shows that there are few extensive wetlands within the study area. The largest group of wetlands are associated with the floodplains and bankline of the Wyaconda River and its former channel. The historic floodplain in the upper portion of the River averages about 1 mile wide. However, numerous levees have reduced the functional floodplain considerably in many areas. Wetlands in the floodplain are usually classified as palustrine forested, palustrine scrub-shrub, or palustrine emergent (Cowardin et al. 1979). There are numerous unconsolidated bottom wetlands (i.e., farm ponds) scattered throughout the uplands of the study area, created primarily to provide livestock water.

The highest concentrations of forested wetlands are found along the Wyaconda River in the following areas:

-T.62N., R.6W. sections 17, 21, and 28;

-T.62N., R.7W., section 1;

-T.63N., R.7W., sections 4, 5, 9, 14, 15, 23, 26, and 35;

-T.64N., R.7W., section 31;

-T.64N., R.8W., sections 5, 8, 9, 14, 15, 16, 23, 25;

-T.65N., R.9W., sections 25, 26, 36;

The Soil Conservation Service's wetlands inventory has yielded similar findings to those of the Service's National Wetlands Inventory. The most prominent wetlands identified, in addition to those the Service has mapped, are farmed wetlands. The largest number of farmed wetlands are found in the floodplain of the Wyaconda River.

Endangered Species

In accordance with Section 7(c) of the Endangered Species Act, we have determined that the following federally-listed species may occur in the project area. No designated critical habitat occurs in the project area.

Species	Federal Status[1]	Status in Missouri	County	Habitat
Bald Eagle (Haliaeetus leucocephalus)	E	Migrant, winter resident, rare breeder along some of the major rivers in the state	Clark Lewis	Large lakes and rivers
Fat pocketbook pearly mussel (Potamilus capax)	E	Probable in Dunklin Co.; recently introduced into Mississippi River in Pike Co.	Clark Lewis	Large rivers
Higgins' eye pearly mussel (Lampsilis higginsi)	E	Mainly along Mississippi R. and its tribs.	Clark Lewis	Large rivers
Indiana bat (Myotis sodalis)	E DCH	Scattered throughout the state designated critical habitat in Crawford Franklin, Iron, Shannon, Washington Co.s	Lewis	Limestone karst caves; forage along riparian corridors and forested hillsides

[1] E= Endangered, T= Threatened, PE= Proposed for listing as Endangered, PT= Proposed for listing as Threatened, DCH= Designated Critical Habitat

The preceding table includes federally-listed species that may occur in the project area, and does not constitute consultation nor fulfill requirements under Section 7(a)(2) of the Endangered Species Act of 1973, as amended. When specific project information is made available, we will be able to provide more detailed comments. If the U.S. Army Corps of Engineers determines that a project may affect listed species, formal or informal consultation should be requested with this office.

Bald eagles have become more common nesters in Missouri, largely because of increased management efforts. However, the greatest number of eagles occur in spring and winter when migrating birds spend several weeks in Missouri. They concentrate around open bodies of water, usually perching or roosting in tall trees that line river banks.

The Indiana bat is a permanent resident of Missouri. It usually winters in caves. However, during the spring and summer months, the females congregate in maternity colonies under the loose bark of trees. The Indiana bat forages extensively along riparian areas and over streams.

The fat pocketbook and Higgins' eye pearly mussels are not found in the project area, but do occur in the Mississippi River immediately downstream.

Fish and Wildlife Resource Problems and Needs

Aquatic

As mentioned above, the upper portion of the Wyaconda River has been extensively channelized. As a result, the river has lost approximately 50 percent of it's length. Consequently, at least 50 percent of the aquatic habitat has been lost.

The available suitable habitat within the existing channelized river has been degraded as well. The remnant oxbows have been filled in or silted in, and no longer can function as spawning and temporary water storage areas. The loss of aquatic resources, both quantitatively and qualitatively, has been much greater than the physical loss of half of the pre-channelized configuration.

Channelization has resulted in loss of in-stream cover, elimination of deeper pool habitat in the upper reaches, increased water velocities upstream, and increased sedimentation downstream. Conversion of native prairie and forest land to agriculture has contributed to increased sedimentation, and increased levels of organic chemicals entering the watershed, degrading the water quality.

Terrestrial

Over half of the forested habitat in the River basin, especially in the floodplain of the Wyaconda River, has been eliminated. Reduction and removal of forested riparian areas has adversely affected the habitats of the great blue heron, green heron, river otter (Lutra canadensis), mink (Mustela vison), and other species. Such activities have contributed to the loss of suitable habitat for the federally-listed Indiana bat. Native prairie has been plowed for row crop production or planted to fescue pasture. These activities have significantly reduced wildlife habitat diversity, breeding habitat, and cover.

Wetland Resources

Channelization and the construction of levees to attempt to control flooding, have allowed the forested wetlands of the floodplains to be cleared for agricultural purposes. Drainage ditches, filling of scour areas and old oxbows, and land leveling also have contributed to wetland losses.

These activities have reduced flooding upstream while increasing flooding downstream. However, downstream flooding is probably not as frequent as it once was, but it is of greater magnitude when flood events do occur. This alteration of hydrology has further degraded the remaining wetlands, especially depressional areas that are not recharged as frequently by flooding.

Conclusions and Recommendations

This planning aid letter has presented a general description of the project area, and some of the major natural features and fish and wildlife resources present. Land-use changes and their impacts to natural aquatic, terrestrial, and wetland communities have been discussed.

The following recommendations are provided to assist the Corps in developing a project proposal for the Wyaconda River basin flood control study that would benefit fish and wildlife and their habitats:

-since channelization already has resulted in the loss of tens of miles of riparian habitat in the project area, we discourage any additional channelization attempts, as they would probably only exacerbate existing problems.

-the construction of unified levees along the channelized or the downstream portion of the Wyaconda River would further constrict the floodplain and potentially create

flooding problems upstream of such construction. A further reduction in the floodplain would contribute to even greater wetland losses in the area.

-re-establishment of the floodplain would provide flood reduction benefits, while also improving fish and wildlife habitats. This may involve levee realignment and further from the river channel in some areas. A larger floodplain would function as a temporary storage area, would allow for the settling out of sediments, enrichment of the soil, would increase groundwater recharge, and would contribute to improved water quality downstream. Fisheries resources and wetland habitats would benefit from connecting the old channel to the channelized portion of the Wyaconda River in areas where significant portions of the old meanders remain.

-aside from the above river channel improvements, adjacent wetlands could be restored through alteration of existing levees and construction of others to impound flood waters and hold run-off. Initiation of a wetland easement/enhancement program, in conjunction with ongoing Section 10/404 and "Swampbuster" regulation, as well as with the Service's and Missouri Department of Conservation's private lands wetland restoration program, could help to preserve and restore wetland resources within the study area.

We appreciate the opportunity to review the proposed project. Should you have questions concerning these comments and recommendations, or if we can be of any further assistance, please contact Richard Szlemp at the address above, or by telephone at (314)876-1911 or (FTS)276-1911.

Sincerely,

Jerry J. Brabander
Field Supervisor

Literature cited

Anderson, Jane. 1983. Missouri Natural Features Inventory. Addition to the Eight County Natural Features Inventory: Scotland, Clark, Knox, Lewis, Shelby, Marion Counties. 47pp.

Cowardin, L.M., V. Carter, F.C. Golet, and E.T. LaRoe. 1979. Classification of wetlands and deep water habitats of the United States. USDI, Fish and Wildlife Service. Washington, D.C. 131pp.

Thom, R.H., and J.H. Wilson. 1980. The natural divisions of Missouri. Transactions of the Missouri Academy of Science, Vol. 14, pp. 9-23.

cc: MDC: Jefferson City, MO (Attn: Dan Dickneite)
MDC, Jefferson City, MO (Attn: Dennis Figg)

RRS:rs:XC:WYACPL

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